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EL PROGRESS

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DIESEL PROGRESS

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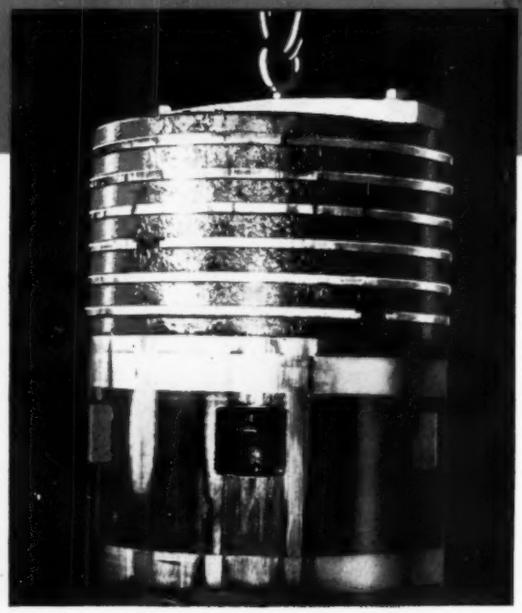
OCTOBER, 1948

FIFTY CENTS PER COPY

step up efficiency

step down costs



Piston being pulled from Nordberg 5-cylinder, 1250 hp, 2-cycle Diesel after operating 11,000 hours at 90% load . . . lubricated with *Texaco Ursa Oil*. All rings are free in their grooves. Brightness of rings and copper bands indicates perfect contact with cylinder liner . . . for full compression, top efficiency and economy.

Keep rings free with Texaco Ursa Oils

WHEN you look at the parts of a Diesel that has run thousands of hours lubricated with *Texaco Ursa Oils*, you'll find them in A-1 condition . . . rings still free . . . valve stems clean . . . cylinder walls bright and smooth . . . bearings still good for further service.

Texaco Ursa Oils are made to stand up under heat and pressure . . . to stand off sludge, varnish and carbon formations. Their use assures high efficiency, low fuel consumption, low maintenance costs.

Texaco Ursa Oils are approved by all leading Diesel manufacturers, and—

More stationary Diesel hp in the U. S. is lubricated with Texaco Ursa Oils than with any other brand.

Let a Texaco Lubrication Engineer help you step up your Diesel efficiency, step down your costs. Just call the nearest of the more than 2300 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

TEXACO

TEXACO Ursa Oils

FOR ALL DIESEL ENGINES

Tune in...Texaco Star Theatre every Wednesday night starring Milton Berle. See newspaper for time and station

DIESEL PROGRESS, for October, 1948. Volume XIV, Number 10. DIESEL PROGRESS is published monthly by Diesel Engines, Inc., 2 W. Forty-fifth St., New York 19, N. Y. Rex W. Wadman, President. Acceptance under the Act of June 5, 1934, at East Stroudsburg, Pa., authorized Mar. 27, 1940. Subscription rates: $5 per year, single copy 50c.

DIESEL and GAS ENGINE PROGRESS

IN INDUSTRY • IN TRANSPORTATION • ON THE SEA • IN THE AIR

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FRONT COVER ILLUSTRATION: Railroads realize the advantages of diesels are not confined to road motive power and they are dieselizing their road maintenance equipment as demonstrated by this International, 'dozer-equipped tractor at work grading a railroad right-of-way.

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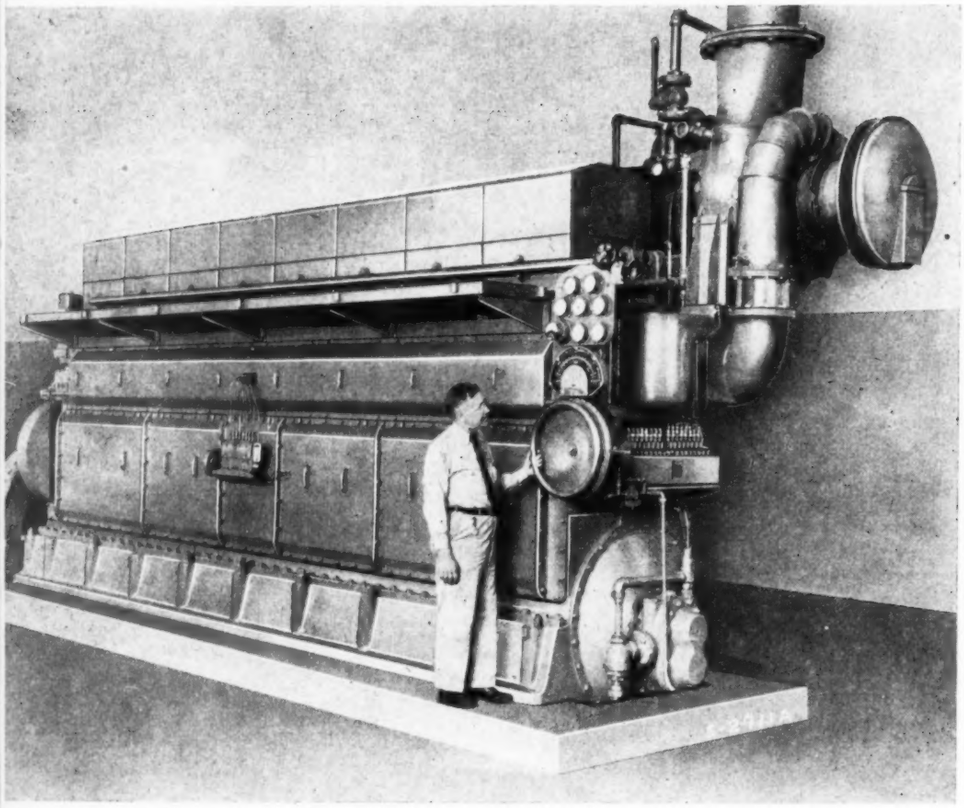
DUAL-FUEL ENGINES FOR WORLD'S LARGEST SLUDGE PLANT



Nine Turbocharged, Dual Fual Worthington engines similar to one in picture above will be installed in Los Angeles Sludge Plant. Each engine will develop 1688 hp at 360 rpm with waste gas fuel and diesel pilot oil.

Los Angeles "Hyperion" Disposal Installation Will Produce 15,000 h.p. on Waste Gas Fuel

By FRED M. BURT

THE huge Hyperion Activated Sludge Plant under construction at Hyperion Beach, El Segundo, California, is designed to meet the sewage disposal requirements of a 3,000,000 population, in and around Los Angeles. It will be the largest individual plant of its kind in the world, although the combined capacities of similar plants in New York and in Chicago, are larger.

The Power and Blower Building and its equipment will represent an investment of $3,579,000; the nine Supercharged Dual-Fuel, Worthington, 1688 hp. engines, the engine lubricating, fuel oil, and air-starting systems, the control panels, and Vapor Phase cooling and waste heat recovery system running up to about $2,000,000.

In full operation, the plant will produce daily, about 4,000,000 cu. ft. of 600-650 b.t.u. sewage gas; 60% for engine fuel and 40% piped to the filter and dryer system.

The North Outfall starts at Canoga Park, far out in the San Fernando Valley, traveling around and down through the western side of the city, growing in size to a semi-elliptical sewer, about 10 ft. high in the center. The Central Outfall comes down from central Los Angeles by a different route.

The outfalls feed into the headworks where bar screens, chlorination and detritor units remove the sand and grit. Pumped then through two 108 in. Venturi Meters (from Builders Iron Foundry, Providence, R. I.) the sewage passes into the pre-aeration sections of the East and West Batteries of the underground Primary Settling System, for a 30 minute treatment.

After 1½ hours slow movement through the Primary Settling System, where 60% of the solids are removed, the sewage travels on into the Aeration System for a four hour detention.

The mixed liquor, or combination of settled sewage and activated sludge, has its solids prevented from settling by 100,000 cfm. of air bubbling up through it. The activated sludge introduced into the sewage, supplies aerobic bacteria, which feed on the raw sewage solids entering the Aeration System, causing the smaller particles to flock into settleable solids.

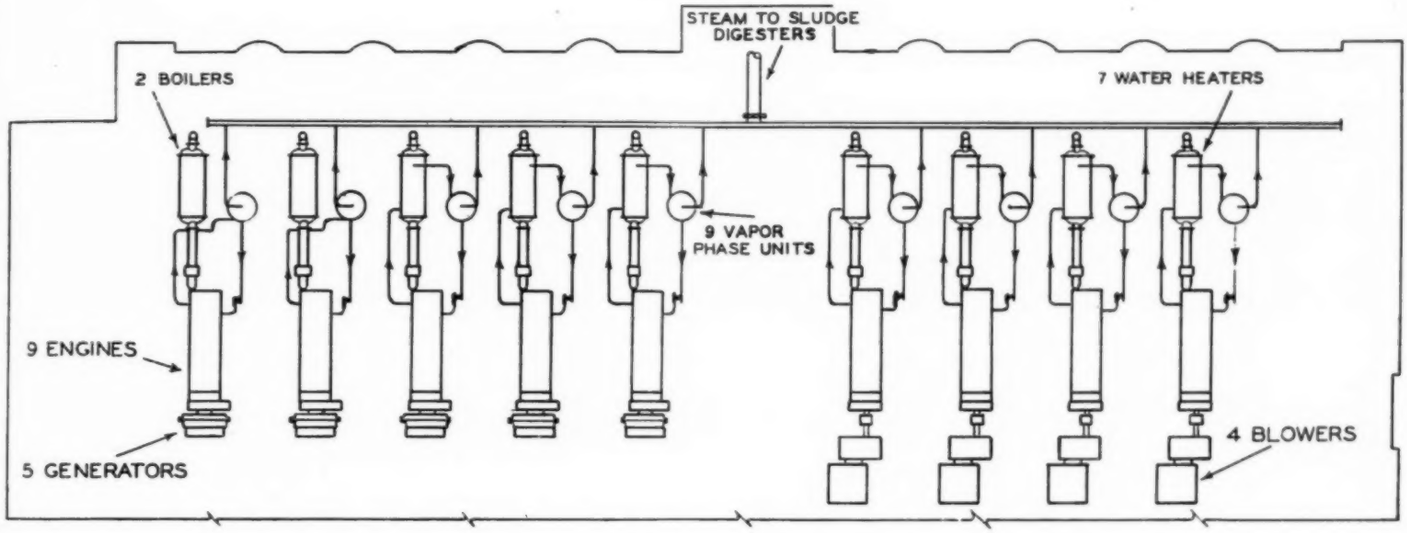
After this four hour slow travel, the mixed liquor enters the Final Settling System for 1½ hours detention, where about 95% of the solids are settled out. This clarified effluent is carried out through the submarine outfall, to be released one mile offshore in the Pacific Ocean.

About 25% of the solids settled out, is returned to the Aeration System to supply the aerobic bacteria; the other 75% is returned to primary settling to be re-settled with primary sludge.

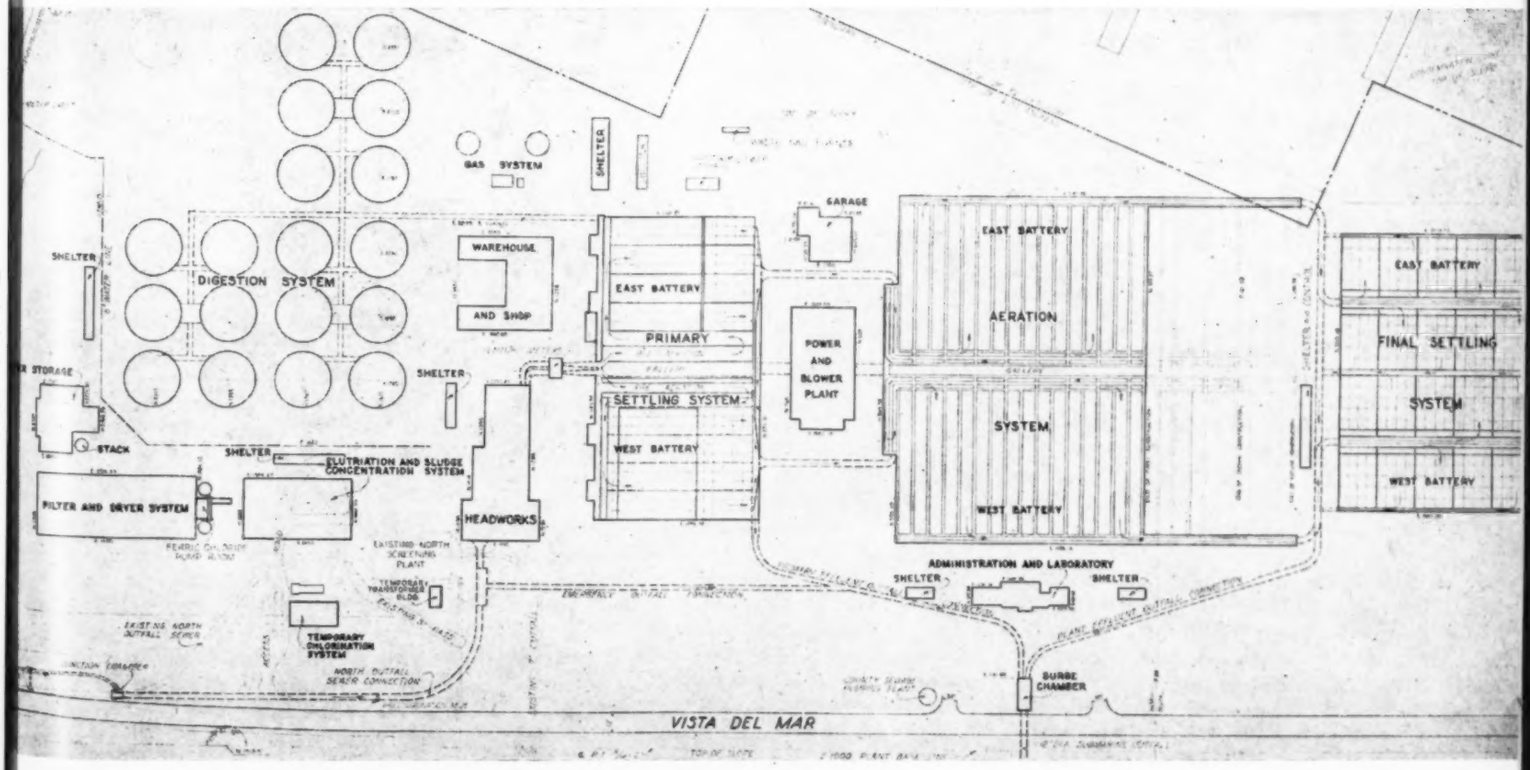
All of this sludge is pumped to the 18 digesters.

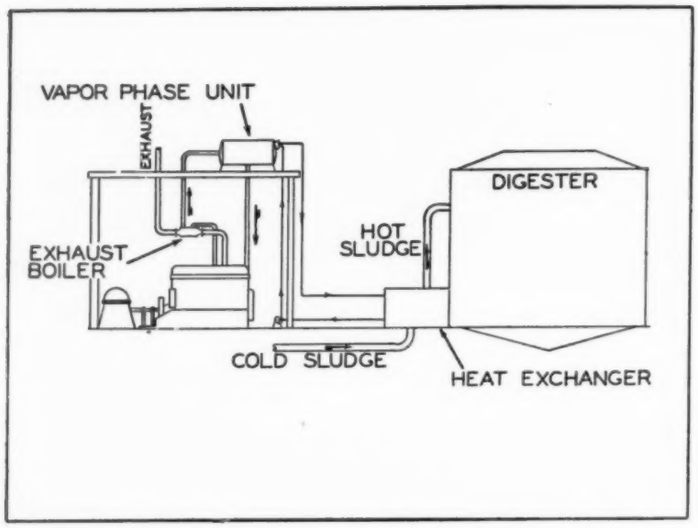
View of Power and Blower Building as it will appear when completed. It will house over 15,000 diesel horsepower.

Schematic layout of Power Building showing engines with generators and blowers in position. Note also layout for Maxim exhaust heat recovery units and Vapor Phase installation.



Drawing of entire plant showing position of Power Building (center). This plant is the largest of its kind in the world.





Typical schematic drawing of sludge plant operation showing use of waste heat for sludge digestion.

Projected Performance Tables for Heat Recovery

Given	Jacket Heat Btu./Min.	Exhaust Gas Lbs./Hr.	Exhaust Gas Temp. °F.
100% Load	36,500	19,700	650
75% Load	28,000	16,800	600
50% Load	19,000	14,800	500

Quantity Steam Per Engine Per Hour

		18″ max.-lbs.	16″ max.-lbs.
(a) Combined System 7 engines	100% load	3,535	3,490
	75% load	2,745	2,700
	50% load	1,865	1,837
(b) Engine Cooling, only 2 engines	100% load	2,130	
	75% load	1,630	
	50% load	1,120	
(c) Engine Boiler, only 2 engines	100% load	1,045	1,000
	75% load	793	756
	50% load	470	447

(a) Heat from exhaust and jacket to 10 lb. steam
(b) Heat from jacket to 10 lb. steam
(c) Heat from exhaust to 75 lb. steam for (cleaning purposes)

Above is based on make-up water at (a) (b) 162°F. and (c) 86° F. No allowance for blowdown or radiation.

(Right) Summary of heat balance calculations for Hyperion Sludge Plant.

In these huge, cylindrical, 110 ft. diameter, 35 ft. high tanks, the sludge remains for 45 days, during which the solids are reduced by 40% through the digestive action of anerobic bacteria which actually destroys the solids; converting them to water and gas.

This methane gas, (65% CH_4, 35% CO_2) is collected from the tops of the concrete dome-covered tanks, having a pressure of about 6 in. water (.216 psi.) This gas is collected in two, 100,000 cu. ft. capacity storage tanks. The low pressure tank has a floating cover and the high pressure tank, a Horton sphere, will have its contents compressed to 50 psi.

The sludge from the digesters will be pumped to the Elutriation (washing) and Sludge Concentration System, where it is washed to reduce the ammoniacal content. This lowers the ferric chloride demand. Ferric chloride being added to condition the sludge, causing the particles to flock together, thus adding to solids concentration.

Passing on into the Filter and Dryer System, the sludge enters 12 vacuum filters to be drawn through filter cloth for reduction of water content from 94% to 75%. The sludge is now in cake form and these cakes are to be carried on conveyor belts to the sludge drying furnaces, which will be fired with the low pressure gas, supplemented by natural gas or fuel oil as required. The filter cake will be dried to 10% water content and sold as an excellent soil conditioning agent to farmers.

The nine, Worthington Pump and Machinery Corp., 8 cyl., 1688 bhp., Supercharged Dual Fuel engines (to be delivered in Spring of 1949) will operate on 5% pilot diesel fuel at all times, with 95% sewage gas reduced from 50 lbs. to 15 lbs. at each engine with standard regulators. Whenever the full 95% demand is not met with the sewage gas, the gas deficiency will be made up automatically with fuel oil, maintaining the full load and speed at all times.

Five of the engines will be direct-connected to 1180 kw. AC, 4800 volt generators. The other four connected through 10:1 step-up gears to two-stage, DeLaval centrifugal blowers, each with a capacity of 40,000 cfm. at 7¾ lbs.

There will be no steam boilers in the plant. All steam required will come from the Vapor Phase engine cooling and waste heat recovery system which is built in.

This heat recovery system is to be supplemented by the installation of nine exhaust heat recovery units supplied by the Maxim Silencer Company. The Maxim installations on seven of the engines will supply hot water, while the remaining two Heat Recovery Silencers will be used to supply process steam at 75 psi. This 75 lb. pressure will be reduced to 10 lbs. by pressure reducing valves and used in conjunction with the process steam developed by the Vapor Phase installation when not required for high pressure work. The Vapor Phase set-up is seen in the accompanying drawings. Each engine when fully loaded will produce about 3,500 lbs. of steam per hour. The steam of 10 psi. gauge pressure, will be injected direct into the slude to heat it to the proper temperature for digestion. Treated make-up water is supplied to the Vapor Phase units to replenish the water evaporated. When all engines are operating at full load, there will be about 30 million b.t.u.'s per hour of heat available. The savings in cost for fuel and upkeep and the savings in the equipment installation and other items of capital investment will be considerable in this case. In addition the reduced wear due to constant high temperature should result in substantially lower costs of maintenance for the engines. The fact that sewage gas is highly corrosive under conditions where moisture is present makes it essential to maintain high temperatures.

The protection of engines from the corrosive products of sewage gas by high temperature operation has been demonstrated by a number of West Coast installations. Among these are the city of Visalia, Bakersfield, Oxnard and San Bernardino. Visalia, with 72,000 hours of engine operation still has in use the original liners, pistons, valves and guides.

The nine Supercharged Worthington Dual Fuel diesels are rated at 1688 bhp. each. They are 8 cylinder with a bore of 16 in. and a stroke of 20 in. Their rated speed is 360 rpm. The mean piston speed is 1200 fpm. at rated speed. Bmep. for both dual fuel and diesel operation is 115 psi. Each engine will be equipped with oil purifiers. Two centrifuges will also be installed for additional purification of the lubricating oil.

The only modification required by the use of vapor phase cooling by these Worthington engines is that the passage of cooling water is straight through the engine from botton to top. No reverse flow is utilized. The reason for this is the necessity of avoiding spots where air pockets can form in the circulating system. Also, the rate of flow of the cooling water is increased appreciably when the vapor phase system is utilized and straight pass flow is most suitable.

When completed this Hyperion plant should be the most modern in the world for it incorporates three of the most successful improvements in engine and plant design made in recent years. First is the use of dual fuel operation for the engines. This factor makes the burning of gas possible on the diesel cycle and results in a thermal efficiency at least 8% higher than an otto cycle engine, which, up to a few years ago was in vogue for gas burning installations. The second is the use of Supercharging to increase thermal efficiencies even higher with a corresponding increase in output, which in terms of bmep. for the Worthington dual fuel engine means an increase from 85 psi. to 115 psi. and in terms of hp. an increase from 1170 bhp. to 1688 bhp. The third is the use of vapor phase cooling which converts engine waste heat, both cooling water and exhaust into useable power in the form of steam. These three advances in engineering applied to this installation weigh the scales heavily towards making the Hyperion plant one of the most efficient in the country on the basis of heat efficiency.

Brady's "White Way"

Texas Municipal Diesel Plant Pays System and Other Improvements For Town's New Street Lighting

Exterior of Brady's modern municipal power plant.

By EDWARD GEESLIN*

POWER was turned on for the final section of a downtown white way street lighting system in Brady, Texas, recently, providing the progressive citizens of that community with an additional 1,318,000 lumen of "light-as-day" illumination on that city's main streets.

And as officials of that city ceremoniously threw the switch for a system of street lighting that provides increased traffic safety, added protection from street crime and greater business possibilities for its downtown merchants, Brady's citizens recognized again that their municipal light plant is probably the best investment they ever made.

The light and water plant, as a matter of fact, paid the cost of those lights out of its profits and will furnish free to the taxpayers the cost of operating them. The Brady Light and Water Plant has been performing civic duties like these for the last fifteen years while, at the same time, furnishing the city with power, light and water at rates that compare favorably with most cities.

Plant records disclose that up to this year, the plant has advanced to the city of Brady somewhere between $700,000 and $800,000. This money has been used for the purpose of buying modern fire-fighting equipment, to pay for proper police protection, for recreational facilities for both adults and children and for innumerable other purposes that ordinarily are defrayed by the taxpaying citizens of a community.

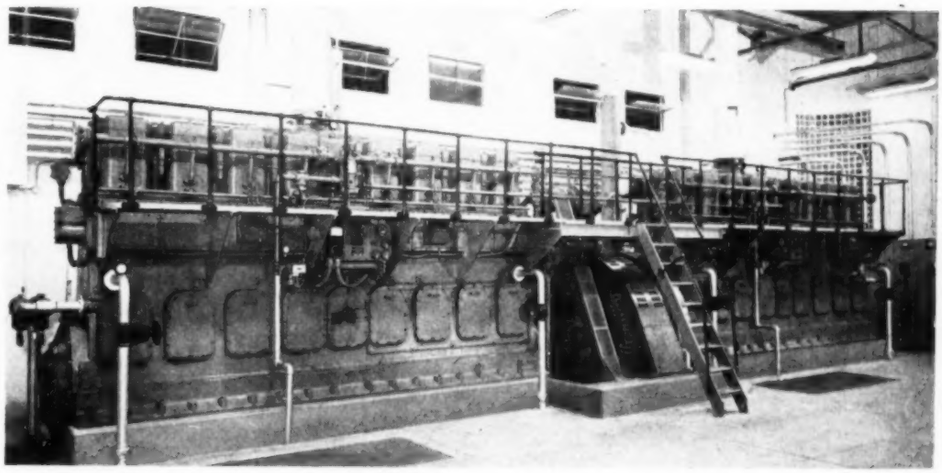
The real estate tax in the City of Brady has been $1.00 per $100.00 valuation but the assessed value for taxpayers has been about 60% of the true value of the property. This tax money has been used in the past to reduce the bonded indebtedness of the city, as the operating expenses of the city were paid by the extra income from the Water and Light Department. The past year we have been able to use 90% of the income from taxes to defray the general operating expense of the city because a surplus had been built up in the tax funds over the amount necessary to meet the bonded indebtedness.

A part of this new equipment which has helped make all this possible is a Cooper-Bessemer Type LS-16 cyl. gas-diesel engine which was deemed necessary to replace three diesels and a gas engine which have outlived practical operation.

The Cooper-Bessemer gas-diesel development not only permits full diesel efficiency, reliability and economy while burning gas as fuel, but actually surpasses, even at fractional loads, the best known performance of oil burning diesels.

**Superintendent The Brady Water & Light Co.*

16-cylinder gas diesel of Cooper-Bessemer manufacture installed in Brady plant. It is rated at 2000 hp at 300 rpm.



The new gas-diesel has been in operation since July 1st, of last year and, on the basis of its record so far, it is expected to cut the city's fuel oil costs by at least 62½ per cent this year. Considering the fact that the price of fuel oil has increased from $1.05 per barrel to $2.95 per barrel in recent months, it is obvious that the use of 90 per cent gas and only 10 per cent fuel oil will afford tremendous fuel cost savings.

The Brady plant gas-diesel at the present time is operating at full capacity nine hours a day, at two-thirds load six hours per day and the rest of the time at half load. The engine is rated at 2,000 hp. at 300 revolutions per minute. It has been in operation a total of 7,000 hours since it was started last July and it's estimated that power is being produced by the station at a cost of .00446 cents per kilowatt hour.

In addition to creating power, the station is also pumping and distributing nearly 30 million gallons of water a month. During the short month of February of this year, the plant pumped 29,075,000 gallons.

The profits of the water and light plant in Brady not only pay for street lighting and the other city expenses mentioned, but it furnishes one half of the power for all schools and one half the power for church lighting without cost to those institutions. Brady has six schools and from 12 to 15 churches.

The city paid $30,000 in cash for the new street lights which recently went into service.

The fact that the plant's new engine now enables Brady to sell over 100,000 kw. of power each month to the Public Utilities serving other sections in that area, is also a great source of satisfaction to the city's officials. Prior to the installation of the new gas-diesel, the plant had to buy from 150,000 to 160,000 kw. of power from that same public utility.

Brady also sells over 100,000 kw. a month to the Rural Electrification Administration to help it serve residents in outlying communities.

Fuel consumption records compiled for the last eight years of operation for the Brady plant indicate to some extent the fuel savings that will accrue as a result of gas-diesel operation.

During 1947, the station consumed 162,720 gallons of fuel oil and 101,648,100 cubic feet of natural gas. It produced 8,112,320 kw. of power.

In 1945 the fuel oil consumption was 160,444 gallons, used 68,643,400 cubic feet of gas and produced 7,123,800 kw. hours.

Figures for 1944 show that 174,902 gallons of fuel oil were used and 72,149,600 cubic feet of gas. Kilowatts produced were 7,394,900.

The Brady Water and Light Plant represents an investment of $1,123,484 to the citizens of that city, yet in reality it has cost them very little because the plant has not only paid its own way, but it has furnished power and water at nominal cost and in addition has furnished the city with facilities that make for added comfort and safety.

The plant was purchased by the city from a private utility in 1912 at a cost of $42,250 and in 1918 the system was changed from D.C. to A.C. current and the city purchased its first engines. The city's water supply, like that of many Texas cities, comes from deep drilled wells and is stored in a million-gallon reservoir.

Progress . . . .

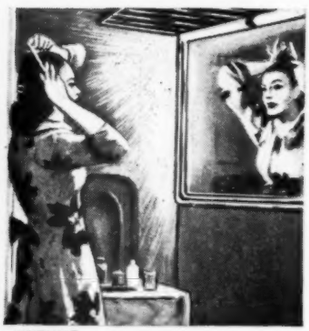
You are cordially invited to visit

the ALL-NEW 20th Century Limited

NEW from its streamlined Diesel to its raised "Lookout Lounge"

NEW! Observation Luxury Lounge. Step into the quiet magnificence planned as a club-on-wheels for the *Century's* distinguished passengers. Decoration is "muted modern." You'll specially like the raised "Lookout Lounge" . . . with huge windows, made for sightseeing along the *Water Level Route*.

NEW! Suite Set-Up For Conferences. See how two *Century* bedrooms open up into one, big enough for conferences or entertainment. At night, space can divide into two bedrooms, each with two beds and *enclosed* toilet facilities.

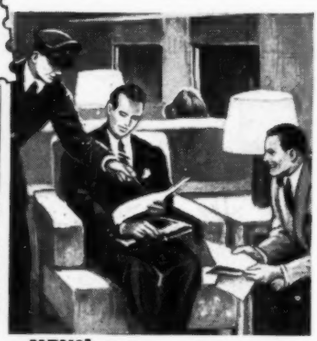


NEW! 1948 Style Rooms and roomettes are air-conditioned personal offices or sitting rooms by day . . . luxurious bed chambers by night . . . and convert instantly into completely appointed and completely private dressing rooms.

ON DISPLAY
THIS THURSDAY
September 16th
Grand Central Terminal
8 A.M.–11 P.M.
Daylight Saving Time

NEW! King Size Dining Car. You'll be delighted at its new spaciousness and beauty. There's a whole long car for dining. The stainless steel kitchen and pantry, with completely electrified refrigeration and dish-washing equipment—are in the next car. Notice the smartly designed silver, china, glass and linen. And notice, too, how a clever arrangement gives each table privacy plus a perfect outlook.

NEW! Radio Phone. It connects with any regular telephone anywhere . . . direct from the speeding *Century* while between New York and Buffalo.



NEW! Mid-Train Club Lounge. Study the way restful colors, ingeniously used mirrors and fluorescent lights add to the feeling of space in this luxurious club car. Here, you'll find the barber-valet shop and radio phone.

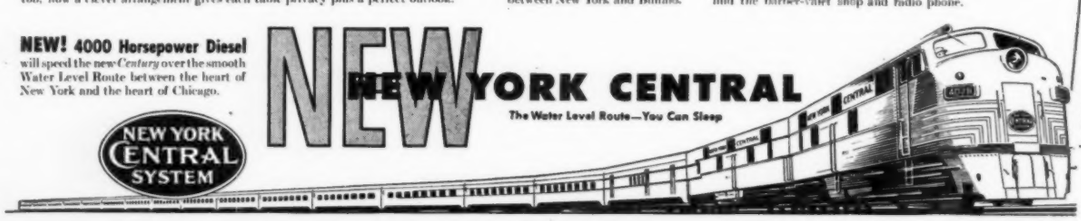
NEW FEATURES *Everywhere!*

- Car doors that open at fingertip touch!
- Interconnecting telephone between all cars!
- Smartly designed silver, china, glass, linen!
- Deep, six-foot-plus rubber-foam mattresses!
- Simplified air conditioning control in each room!
- Roomier wardrobes for clothes and wraps!
- Circulating ice water in *Century* rooms!
- Enclosed toilet facilities in double bedrooms!
- Public address system for special announcements!
- New fold-away easy chairs in bedrooms!

NEW! 4000 Horsepower Diesel will speed the new *Century* over the smooth Water Level Route between the heart of New York and the heart of Chicago.

NEW YORK CENTRAL
The Water Level Route—You Can Sleep

NEW YORK CENTRAL SYSTEM



Maiden Voyage FRIDAY!
The day after this display, the new 20th *Century Limited* will take its place as first and finest of New York Central's private-room *Dreamliner* fleet, bringing New York-Chicago passengers a still better overnight vacation, with no lost business time.

. . Diesel Progress!

These Two Big Eastern Railroad Die-hards Have Joined the Diesel Progress Parade

THESE two advertisements appeared in the same edition of the New York Evening Sun a few nights ago. The two big eastern railroads, featured in these advertisements, that fought the diesel locomotive tooth and nail for years, have now gone all out to embrace the diesel locomotive and to adopt it to the fullest possible extent. More power to them!

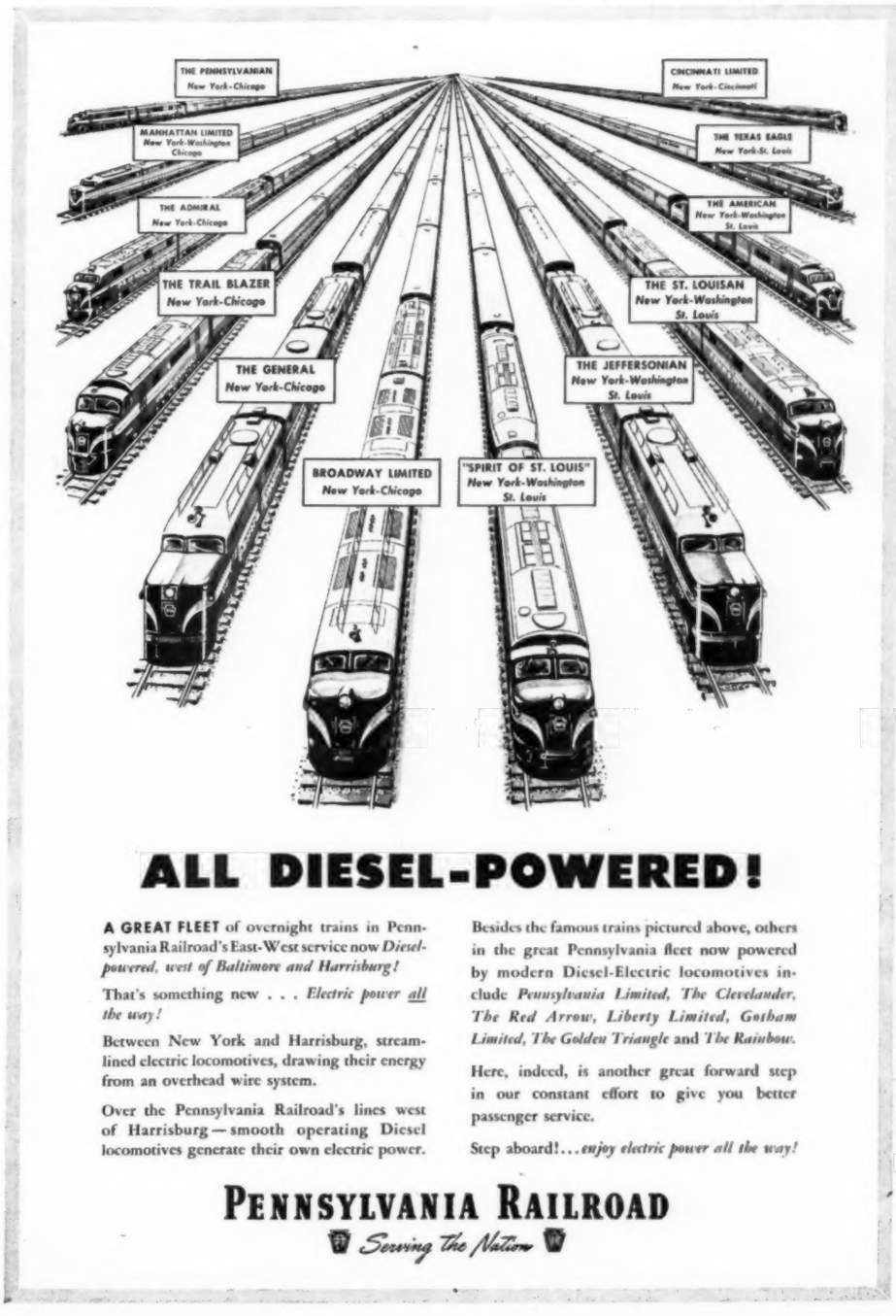
We stop here and now and bow low to the Managements of the Pennsylvania Railroad Company and the New York Central Railroad Company—we admire the manner in which they have boldly admitted the errors of their way and have gone all the way in an honest endeavor to bring their motive power in step with the other big railroad empires that have so successfully adopted and used the diesel locomotive to save them and to make them money.

We here at DIESEL PROGRESS are peculiarly proud of the Pennsylvania Railroad Company advertisement which indicates how completely this super-conservative coal railroad has come over to the diesel side of the fence. It doesn't take much imagination to realize how tough it was for the Management of the Pennsylvania Railroad Company to make this decision.

As you, our readers know, DIESEL PROGRESS has fought for the Dieselization of American railroads from the first day the magazine saw the light of day back in May 1935.

So again we say that it is with a glow of pride that we reproduce these two advertisements and at the same time extend to the Pennsylvania Railroad Company and the New York Central Railroad Company and to the Diesel Industry as a whole our hearty congratulations.

To us here at 2 West 45th Street in the City of New York, these two advertisements mark somewhat of an era or an epoch or something—to us it is a subject for celebration and when the history is written, the publication of these two advertisements on the same date will find its rightful place as marking the victory of economy, of efficiency over stubbornness and precedent and blind worship of the steam locomotive.



ALL DIESEL-POWERED!

A GREAT FLEET of overnight trains in Pennsylvania Railroad's East-West service now *Diesel-powered, west of Baltimore and Harrisburg!*

That's something new . . . *Electric power all the way!*

Between New York and Harrisburg, streamlined electric locomotives, drawing their energy from an overhead wire system.

Over the Pennsylvania Railroad's lines west of Harrisburg—smooth operating Diesel locomotives generate their own electric power.

Besides the famous trains pictured above, others in the great Pennsylvania fleet now powered by modern Diesel-Electric locomotives include *Pennsylvania Limited, The Clevelander, The Red Arrow, Liberty Limited, Gotham Limited, The Golden Triangle* and *The Rainbow.*

Here, indeed, is another great forward step in our constant effort to give you better passenger service.

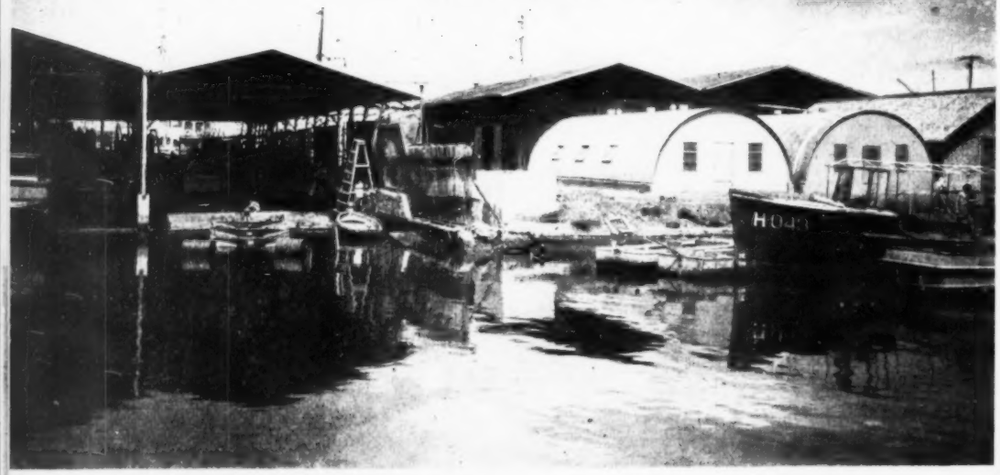
Step aboard!...*enjoy electric power all the way!*

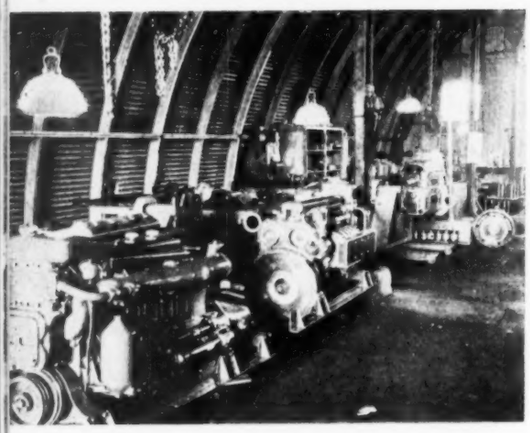
PENNSYLVANIA RAILROAD

Serving the Nation

HEADACHES in the Indies

Netherlander Describes Diesel Maintenance Problems at East Indies Base





(Above) View of repair yard from harbor at Batavia, which services about 1300 General Motors diesels.

(Right) From door of Kreffer's assembly shop can be seen a converted LST in for repairs.

(Left) Assembly line for repairs on General Motors diesels in Quonset type building used by "Vraag En Aanbod."

C. A. KREFFER, now managing director of N.V. Het Technisch Bureau "Vraag En Aanbod" at Batavia, Netherlands East Indies, was an unwilling guest of the Japanese in a concentration camp at Bandoeng for 3½ years. Now Mr. Kreffer is successfully directing this busy diesel engine service and assembly plant at Batavia. Mr. Kreffer has about 1300 Series 71 diesel engines under his care for the Royal Dutch Navy, The Netherlands East Indies Army, "Nirub" (The N.E.I. rubber foundation), the N.E.I. Department of Shipping and for many individual owners. An "owners pool" of GM diesel parts is being built up, amounting to approximately $1,500,000 worth of spare parts. Buildings in which 300 engines were completely overhauled in 1947 were constructed of scrap metal from the war-flattened harbor and three large Quonset buildings were added. Mr. Kreffer's goal is a set-up wherein they shall be able to overhaul four engines a day.

The war damage suffered at Tandjoeng-Priok, the harbor of Batavia, was an accident largely due to Japanese carelessness. "They were unloading a shipload of torpedos with the war heads attached" said Mr. Kreffer, "One of them slipped out of a cable, crashed on the dock and Pouf! the ship, the Japanese and the entire group of harbor buildings at Tandjoeng-Priok just didn't exist any more."

Out of the rubble of flattened "go-downs" and larger buildings Mr. Kreffer and others have scratched out a place to work and to get things done which will help put the Netherlands East Indies back on its feet in time. Just now, due to brigandish bands of outlaw natives, many wartime measures are still in effect. A nightly curfew is observed and to be out after midnight without an official pass to conduct business is a jail offense.

"We are working under difficult conditions as to labor," says Mr. Kreffer. "Mechanical skill among the natives is very rare so we have to train cooks, bicycle repair men and shoemakers how to do specific jobs in engine overhaul. I have made good workmen out of men who never before held a screw-driver or a wrench. Maybe not good all-around mechanics, but at least they can learn all there is to do on one sub-assembly of the engine and if we keep them on that, they get along."

Mr. Kreffer's "hands" are mostly Indonesian and Chinese. Politics cause rivalries within the shop which result in spite-work and sabotage, so that very close supervision is required. Also, according to Mr. Kreffer, the natives who operate the small coastwise and river boats in which most of the Series 71 diesels see service have not the slightest mechanical knowledge. For them to put salt water in a starting battery is not uncommon and if the slightest thing goes wrong, like a plugged fuel line, the result is a "stuck" boat perhaps 200 or 300 miles from any intelligent help.

"Our territory is extremely hard on engines," said Mr. Kreffer. "The fuel oil and lubricating oil obtainable in the backwoods are very poor and this, together with the absolute lack of skill on the part of the operators, greatly limits the serviceable life of engines between overhauls."

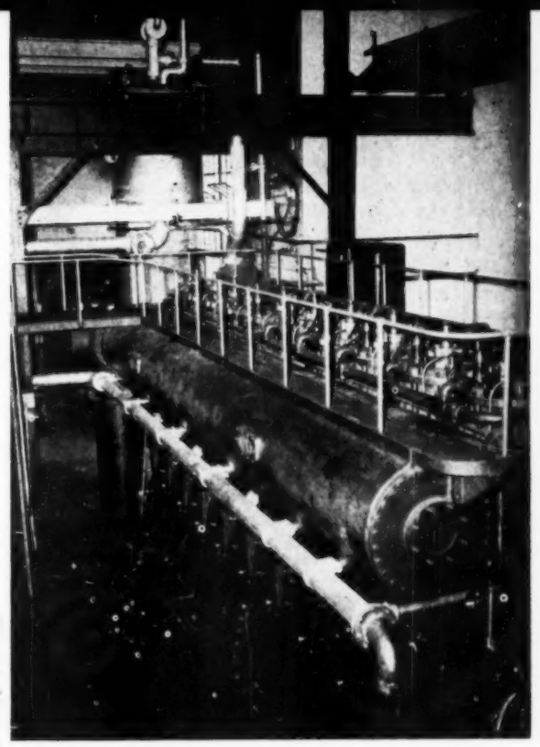
To assist in emergency calls and to service the GM diesel auxiliaries on the large ships at anchor, a war-surplus L.C.P. has been fitted up with a spare parts stock and is kept very busy.

Mr. Kreffer has been in the United States since June 3, visiting General Motors Overseas Operations in New York City and the Detroit Diesel Engine Division of General Motors at Detroit. He is avid to learn the latest engine repair methods and to accumulate the newest engineering information and tools.

"Life on Java is not much fun right now," says Mr. Kreffer, "We have the necessities of living but of course no luxuries such as Americans are used to. Not only is gasoline rationed but so are automobiles — rationed strictly for business use. On the other hand, although I am a Hollander, the East Indies is 'my' country and I have a feeling I should stay with it and try to help build it up. But if another war should come . . . I don't want to be there."

224° f-Cooling Water!

By B. C. SISSON



(Right) Now famous No. 8. Busch-Sulzer diesel equipped with "Vapor Phase" cooling unit.

View of Freeport, Long Island, diesel plant which has been in service since 1921.

Freeport Diesel Plant Successfully "Vapor Phases" first 3000 hp. Diesel to produce 5000 pounds of heating steam and obtain more efficient operation.

AT 1 P.M. the afternoon of February 1, 1948, in the presence of Nordberg, Westinghouse and Engineering Controls representatives, Tom Moore gave the air to Freeport's No. 8 Busch-Sulzer, the first big diesel to be "Vapor Phased." This 3000 hp. diesel has been operated ever since, without mishap, at a cooling water temperature of 224° F. It is the first installation of its type and the credit goes to the group who made it possible.

The Village of Freeport has had long experience with diesels which dates back to 1921 when its first 250 kw., air injection Busch-Sulzer diesel was placed in service. Since that time, nine Busch-Sulzers have served faithfully and well in the municipal plant. At present, there are only 6 diesels in the plant, the first 3 having been removed to make room for larger units as load demand increased. Now, the postwar influx of population to Freeport has resulted in the purchase of a new 3850 hp. Nordberg diesel, which will be installed shortly. The plant capacity will then total over 11,000 kw.

Freeport's venture into high temperature cooling had its beginning when Tom Moore took over the plant superintendent's job in 1947. He had had experience with this type of cooling and was thoroughly sold on the idea. It presented theoretical and practical advantages which were tantalizing to this imaginative engineer. Briefly, two of these advantages appealed to him: The generation of heating and process steam by the engine; and the more efficient and economical operation of the plant.

Moore started right in convincing the village trustees of the advantage to be gained from high temperature cooling. His first convert was Mr. H. F. Carpenter, who became very much interested in the idea. Within a matter of a month or so the idea was O.K.'d and plans were set in motion to convert No. 8 diesel to high temperature cooling. No. 8 is a 3000 hp. Busch-Sulzer, 10 cylinder, 19½ x 27. The engine had been installed in 1936 and at the time of conversion had operated a total of 35,421 hours.

The cooling system, before "Vapor-Phase," was an open type. Mr. Moore investigated all other conventional cooling systems and decided to go ultra-modern by calling in Engineering Controls, Incorporated, to install a "Vapor-Phase" cooling system. A west coast concern, Engineering Controls, had developed this system of high temperature cooling in the 1930's and had made its first diesel installation in 1939.

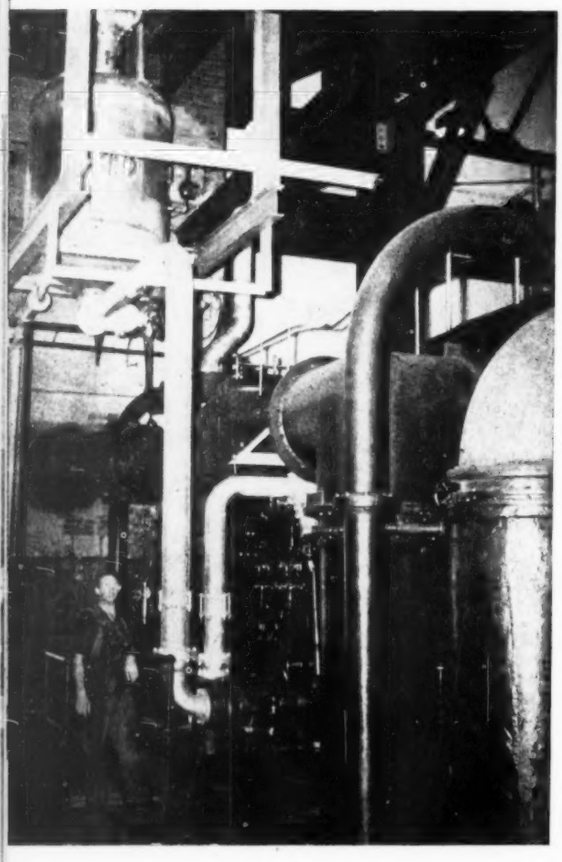
The Busch-Sulzer was not admirably suited for a "Vapor Phase" installation and required several cooling system modifications. These were accomplished by plant technicians under the supervision of Moore. The reason for these changes was that an increased flow of water was required by the new cooling system, and the need for elimination of any possible air pocket forming obstructions in the water passages of the engine. These modifications are shown in Fig. 2. The rate of cooling water supply was increased from 350 gpm. to 900 gpm. The fuel injector cooling system was also modified. To compensate for the expansion of the engine running at higher temperature the timing gears were given an additional .020" end clearance.

With the engine modifications complete, the "Vapor Phase" equipment was installed. The "Vapor Phase" unit, a cylindrical tank 96 inches high and 60 inches in diameter was mounted on a platform with its base 8 ft. above the engine base to provide a sufficient head to the 1200 gpm. Ingersoll Rand centrifugal pump below. This height is required to prevent superheated water from flashing in the pump. The "Vapor Phase" tank is equipped with numerous devices, both for safety and for control. These devices include two pressure relief valves 0-5 psi. which can be set for any desired pressure between these two values. As an additional safety precaution, a safety valve set at 10 lbs. is installed. As may be seen from the drawing, make up water supply is controlled by Clayton automatic valves which are air operated. Thus the water level within the unit is rigidly

controlled. To assure absolute safety the unit is tested for 100 psi. before installation.

The rest of the installation was a simple piping job of connecting up to the engine as seen in the drawing Fig. 1. Dresser flexible connections were used for this job.

Needless to say, as a precautionary measure the original piping was left in place with convenient valves just in case the new system failed.



(Left) View of "Vapor-Phase" unit mounted on platform above the engine. 1200 gpm Ingersoll Rand circulating pump below.

Now, how was this system to operate? In contrast to the former cooling system with water entering the engine at 85° F. and leaving at 100° F., the "Vapor Phased" system supplied water at 224° F. which left the engine at 228° F. Formerly the rate of flow had been 350 gpm. now it was upward of 900 gpm. What changes were effected? In the first place, cooling capacity of the system increased with only a 4-degree differential between inlet and outlet temperatures. Actual thermocouple readings proved this fact. Superintendent Moore took the temperature of the cylinder liner flange under various operating conditions.

With the engine under a constant load, readings were taken of the liner flange temperature which showed the following in various cooling water temperatures.

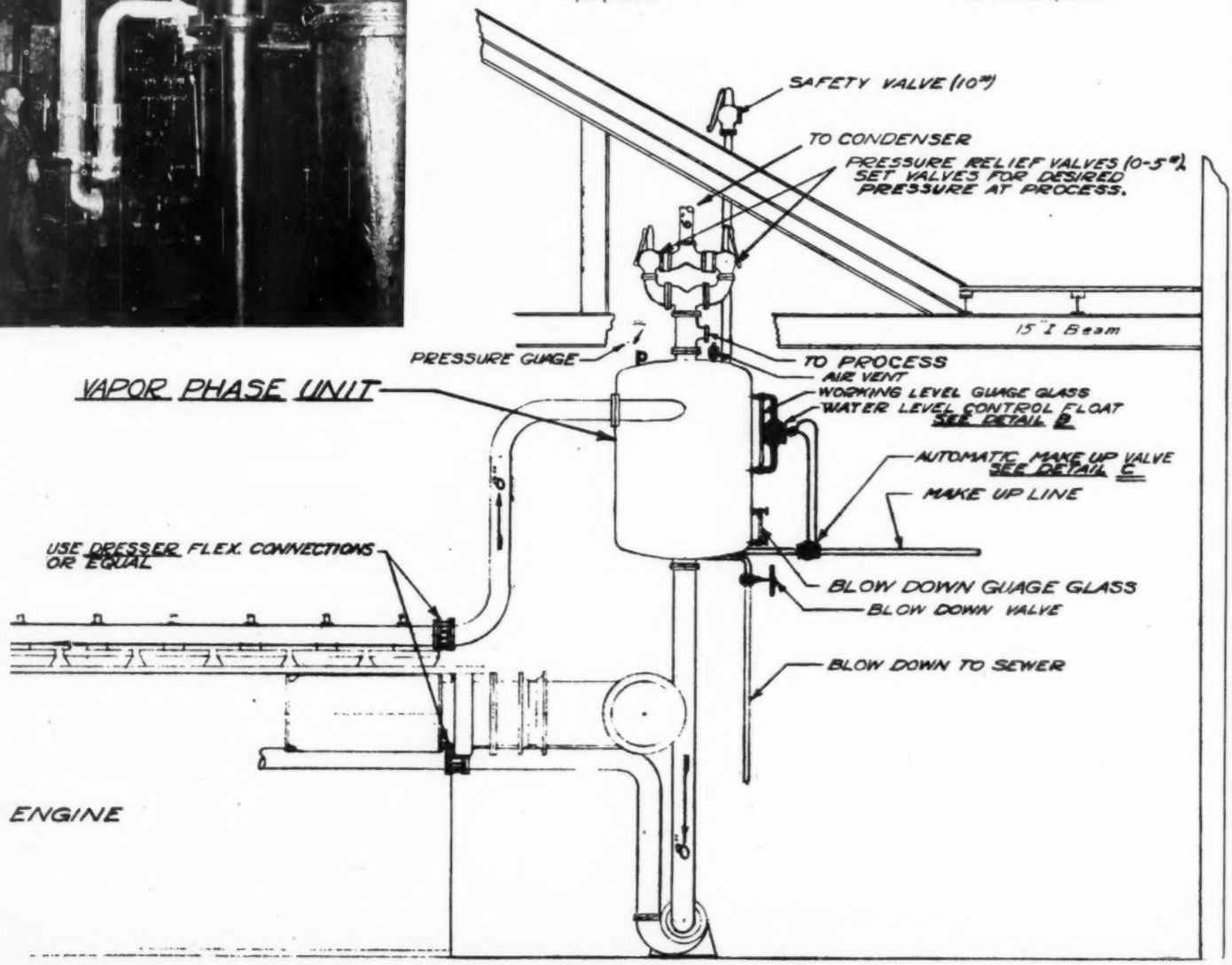
Water In	Water Out	Flange Temp.
83° F.	100° F.	450° F.
140° F.	160° F.	510° F.
224° F.	228° F.	470° F.

The answer for this seeming contradiction lay in the fact that the water in circulation was absorbing a great deal more than 4 Btu's per pound—some of it was, in fact, absorbing heat at the approximate rate of 1000 Btu. per lb. and taking on the latent heat of vaporization. This steam in the form of microscopic bubbles was passing through the engine jackets at relatively high speed to be flashed into the Vapor Phase unit to produce steam.

It is estimated that with the Busch-Sulzer developing 3000 hp., 5000 lbs. of steam at 5 psi. is generated per hour. This is more than enough to heat the Freeport plant. As a matter of fact, during the months of February and March the plant saved an average of 6000 gallons of fuel a month by heating the plant by engine generated steam. The boiler which formerly supplied the steam is now on its way out.

As for the effect on engine operation there is an even longer story to tell. The advantages claimed by the proponents of vapor phase are many. It is stated that high temperature cooling fosters complete combustion of fuel with little residual carbon or soot. This claim has been borne out by the inspection of Freeport's Busch-Sulzer. The engine does run clean. A corollary advantage cited is that corrosive products of combustion SO_2 and other acid combinations are held in a

Figure 1, Schematic drawing of "Vapor Phase" installation showing pipe connections and other pertinent equipment at Freeport Plant.



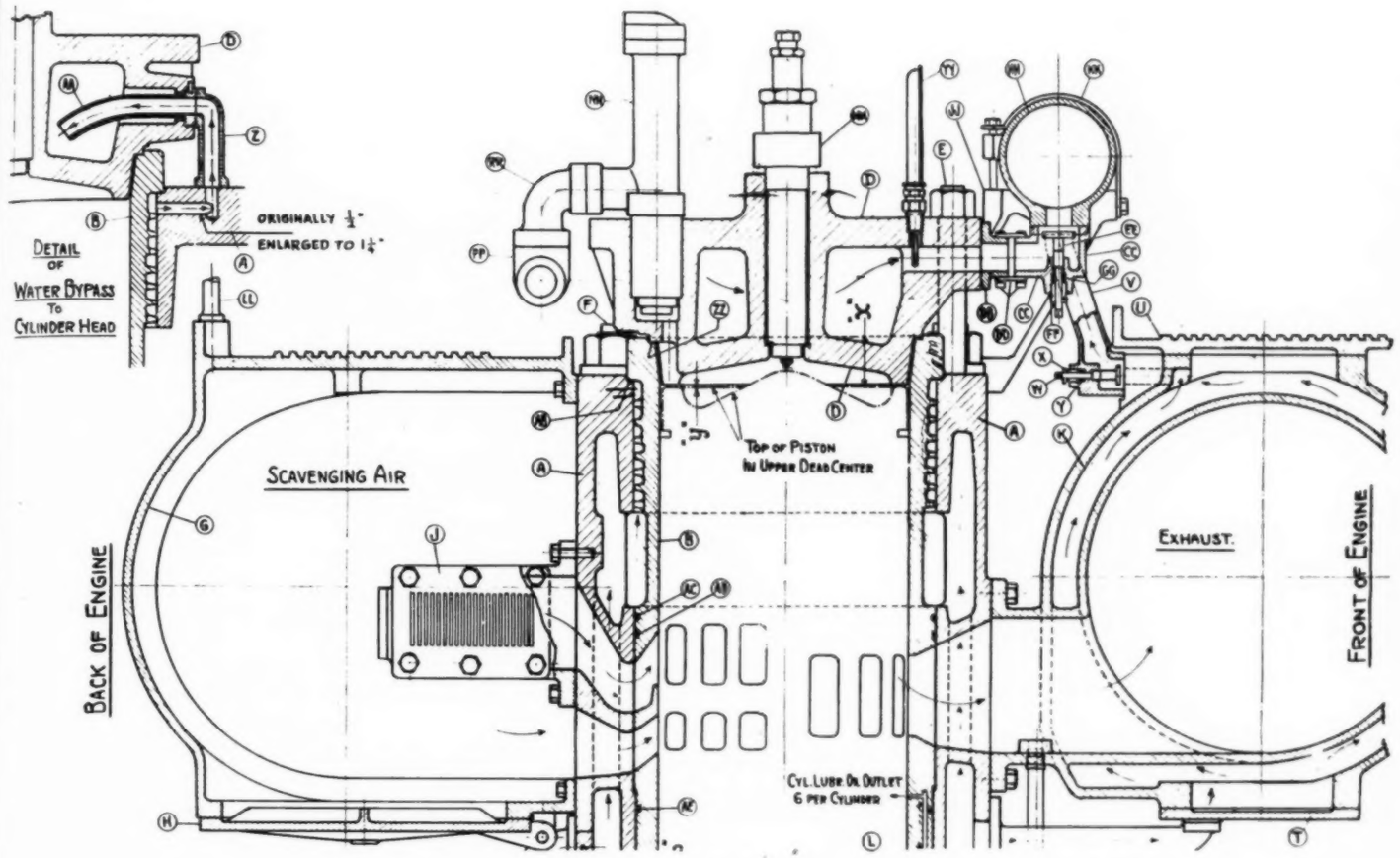

DETAIL OF WATER BYPASS TO CYLINDER HEAD
ORIGINALLY 1/4"
ENLARGED TO 1 1/4"
SCAVENGING AIR
TOP OF PISTON IN UPPER DEAD CENTER
EXHAUST
BACK OF ENGINE
FRONT OF ENGINE
CYL. LUBE OIL OUTLET 6 PER CYLINDER

Figure 2. Cylinder head details of 3000 hp. Busch Sulzer diesel. Changes included widening of Water Bypass to cylinder head (see inset drawing) and removal of water regulating valve (EE) to make for more rapid circulation of water through the engine.

vapor state and cannot attack the engine parts. This contention has been proved true in the many cases where high temperature cooling has been applied to engines running on sour gas. Another factor judged to reduce wear is the even temperature gradient throughout the entire length of liner and for that matter, the entire engine.

The question of fuel and lube oil economy is not yet definitely settled although consumption figures support the theory to some extent.

What is revealing, is the increased output of the Busch-Sulzer following the installation of the new cooling system. Previously the diesel had been developing 1500 kw. with distinct signs of overloading if that rating was exceeded. Now the engine develops 1900 kw. without any trouble. It must be explained here that other contributing factors enter into this improvement, such as changes in the fuel injection valves and other adjustments. Be that as it may, in December 1947 prior to the installation of Vapor Phase No. 8 diesel developed 12.59 kwh./gal. of fuel. In March 1948 after conversion the same engine developed 13.8 kwh/gal. Comparison between the May operating figures for No. 8 and No. 7 diesels, which are identical except for the cooling systems, shows a kwh. production of 13.33 per gallon for the "Vapor Phased" engine and a figure of 12.69 kwh./gal. for No. 7.

Lubricating oil consumption has been low. Oil is pumped to the pistons at 160° F. It leaves the engine at 170° F. Superintendent Moore uses Esso Diol No. 65, an inexpensive oil which has performed excellently. An interesting sidelight is the fact that for a short period oil temperatures were allowed to go up to 200° F. with no bad results. In fact lube oil consumption was found to decrease. Moore's explanation of this is that at higher temperatures the viscosity of the oil is lowered to such an extent that less oil is left to burn on the liner walls during the expansion stroke of the piston.

Furthermore, engine oil has been found very clean and free from acid contaminants.

Hans Bohuslav, Chief Engineer of Engineering Controls, in a recent paper delivered before the National West Coast Meeting of the SAE in San Francisco shed some interesting light on this subject of cylinder liner wear and cylinder temperatures as related to oil consumption. His and other researches have indicated that with cylinder wall temperatures between 176° F. and 536° F. cylinder wear was "slight and practically constant." But when cylinder temperatures dropped below 176° F. wear increased rapidly. At 104° F. the wear rate was approximately 10 times greater than that at 176° F. This wear was reduced considerably by the addition of more oil to the cylinder walls. However the wear rate was still four times that of cylinders at 176° F. Bohuslav went on to say that large engines with mechanical lubricators do not show such bad wear rates at low temperature operation, since such lubrication was constant and ample. However, there is reason to suppose that with high temperature cooling the supply of oil to the cylinders could be cut down without damage to the engine and thus lubricating oil could be saved. The effect of high temperature cooling oil could be the same in this case.

In general, this same relationship is shown in top ring wear, with wear increasing rapidly when cylinder wall temperatures go lower than 176° F. Tom Moore's experience with Freeport's Busch-Sulzer has verified the statement that very slight wear is found when cylinder wall temperatures are kept high. When Moore inspected the Vapor Phased engine after 2500 hrs. of operation, he removed the top ring from one piston and found no sign of wear. The tool marks had been polished off, but the ring was in perfect condition. (It was a piece of this ring that was taken to St. Louis by Tom Moore during the Oil and Gas Power Division Meeting of the ASME last spring as proof the efficacy of high temperature cooling.

The trustees of the village of Freeport have stood solidly behind Moore in this project and have seen their confidence proved. They are: Mayor C. C. Ryan, H. F. Carpenter, Acting Mayor, and Trustees Joseph Gallo, Robert Doxsee, and Leonard Smith. Now with one diesel equipped with "Vapor Phase," Freeport is going ahead with three more. Within a matter of months Freeport's No. 9 Busch Sulzer will be converted. Sometime later No. 7 diesel and the new Nordberg diesel will be "Vapor Phased." When this is accomplished, it will be possible to interconnect the engine cooling systems in such a way that at no time will any engine go below operating temperature even when it is not operating. In this manner the period of greatest wear, that of warming up the engine, will be greatly shortened, perhaps eliminated.

ANALYSIS OF RAILROAD FUEL OIL CONSUMPTION

By DR. O. W. WILCOX*

IT IS generally known that the railroads of the United States burn three categories of fuel in the operation of their locomotives: coal, heavy or residual fuel oil, and diesel oil. The proportions of these fuels in use during recent years has been shifting markedly. Between 1944 and 1947 the consumption of coal has declined 19 per cent, of heavy fuel oil 10 per cent, while consumption of diesel oil has increased 152 per cent. In 1940 the number of diesel locomotives in this country was 967; by the end of 1947 this number had increased to 6,100. The current rate of producing these engines is said to be about 1,800 a year.

This summary comparison may be taken as an indication that economy of operation is counting heavily in favor of diesel oil, which means, of course, that the case of diesel engines vs. steam engines is being decided in favor of the diesels.

One reason for the preference shown for the diesel engine by the railroads is that it is thermodynamically superior to steam engines; that is, it converts a larger proportion of the heat units of the fuel into power units. From the financial standpoint this thermodynamic superiority of the diesel makes itself felt in the railroads' expense accounts as savings in two main items—cost of fuel, and the expense incurred by the railroads in bringing their fuel to where it is needed. The magnitude of this item is apt to be overlooked.

In comparison with coal and heavy fuel oil, it costs relatively little to haul equivalent amounts of diesel oil. This is due to the surprising and too little appreciated fact that there is a great difference in the weights of the different kinds of fuel to produce one service-unit of power. This has been brought out by a digest of recent ICC figures made by N. D. Ballantine for *Railway Age*.

For example, per engine-hour in yard service, where diesel oil consumption was 46.44 lbs., the weight of fuel oil consumed was 11.9 times and the consumption of coal was 19.6 times greater. When the comparison is made on the basis of 1,000 gross ton-miles in freight service, the weight of diesel fuel was 12.24 lbs.; fuel oil was 5.97 and coal 11.19 times more. In road haul passenger service per passenger-train car-mile, the weight proportions were: diesel oil 2.09, fuel oil 4.6 and coal 10.29 lbs. These figures are shown in Table 1.

Table 1. Comparative Weights of Locomotive Fuels.

	Lbs.	Ratios
per switch engine hour		
Diesel oil	46.44	100.0
Heavy fuel oil	552.60	1190.0
Coal	910.00	1960.0
per 1000 gross ton-miles (freight)		
Diesel oil	12.24	100.0
Heavy fuel oil	73.02	596.6
Coal	137.00	1119.3
per passenger-train car-mile		
Diesel oil	2.09	100.0
Heavy fuel oil	9.61	459.0
Coal	21.50	1028.7

These differences in service-unit weights of locomotive fuel show up strongly in the out-of-pocket expense to which the railroads are put for transporting their locomotive fuel. This is illustrated by analysis of figures that reflect operations for the month of March, 1948. In that month the combined weight of coal and fuel oil consumed was 6.84 times the weight of the diesel oil which would have been required to do all the work; in other words, 221.8 million gallons of diesel oil have been equal to 296.2 million gallons of fuel oil plus 7,888,419 tons of coal.

On the basis of experience in this one month, and assuming that if the whole motive power of the railroads were put on a diesel basis, the shrinkage of the weight of fuel hauled would be as shown in Table 2.

Table 2. Savings in gallonage of liquid fuel hauled by supplanting fuel oil with diesel oil—March 1, 1948.

Class of Service	Fuel Oil (1000 gals.)	Diesel Oil Required to Substitute (1000 gals.)	Savings (1000 gals.)
Freight	206,143	152,869	53,274
Passenger	63,044	47,609	15,435
Yard	26,998	21,308	5,690
All Services	296,185	221,786	74,399

This Table says that by supplanting fuel oil with diesel oil, in one month the railroads would have had 74,399,000 gallons less of liquid fuel to handle in bulk.

* Technical Editor, World Petroleum.

Combining coal and fuel oil on the basis of tonnage hauled, the savings would be as shown in Table 3.

Table 3. Savings in tonnage hauled by supplanting both coal and fuel oil with diesel oil—March, 1948.

Class of Service	Coal + Fuel Oil (1000 tons)	Diesel Oil Required to Substitute both (1000 tons)	Savings (1000 tons)
Freight	6,285	550	5,735
Passenger	1,432	171	1,261
Yard	2,463	766	1,697
All Services	10,180	1,487	8,693

Railroad accountants usually wind up by expressing such items in terms of number of cars in use and gross ton-miles of haulage. On this basis we have the comparison of car use shown in Table 4.

Table 4. Savings in car use by supplanting present use of coal and fuel oil with diesel oil—March 1948.

Class of Service	Cars in Use for Coal and Fuel Oil*	Cars Needed for Diesel Oil	Savings in No. of Cars
Freight	57,942	3,287	54,655
Passenger	12,622	1,026	11,596
Yard	13,302	456	12,846
All Services	86,866	4,769	79,097

*Based on estimated 15-day turn around for coal cars, 6 days for tank cars.

Supplanting present use of coal and fuel oil with diesel oil as locomotive fuel would free 79,097 cars for other use.

Table 5. Saving in gross ton-miles by supplanting present coal and fuel oil consumption with diesel oil—March, 1948.

Class of Service	Combined Mileage, Coal plus Fuel Oil	Mileage if Diesel Oil is Substituted for Both	Savings
Freight	2,352,594	276,788	2,084,806
Passenger	541,232	82,955	458,277
Yard	983,736	337,402	646,334
All Services	3,877,562	688,145	3,189,417

Table 5 means that gross ton-miles now expended in hauling coal and fuel oil for locomotives could be reduced from 3,877,562 down to 688,145 by supplanting both with diesel oil. This would be a saving of 563 per cent in mileage.

The eventual payoff comes when the foregoing physical magnitudes are translated into terms of equivalent cash. It will be remembered that the figures in Tables 2 to 5 represent one month's consumption of locomotive fuel by Class I railroads. The relations of quantities and costs are given in Table 6.

And so we come out with the astonishing result that the substitution of diesel-electric locomotives for all of the steam power on Class I road-haul and terminal railways of the United States would mean the annual saving $582,560,604 from just two items alone—the cost of fuel, and the out-of-pocket expense of transporting it.

We may next approach another phase of the matter. If the coal-burning and fuel-oil burning locomotives now in use are discarded they will have to be replaced by an equivalent number of diesel engines, *or rather by an equivalent amount of diesel horse power.*

Table 6. Consumption and cost of locomotive fuel—March, 1948.

Service	Coal Used, tons	Fuel Oil Used, gallons
Road, freight	5,409,598	206,142,979
Road, passenger	1,164,153	63,044,226
Yard	1,314,688	26,997,909
Combined	7,888,419	296,185,114
Diesel oil to replace both		221,786,382
Net reduction in fuel	7,888,419	74,398,732
		Costs
Cost of coal @ $5.02 a ton		$ 39,599,863
Cost of fuel oil @ 5.45c gal.		16,142,098
Combined cost coal and fuel oil		$ 55,741,952
Cost of diesel oil substitute @ 10.43c gal.		$ 23,132,320
Reduction in fuel cost, 1 month		$ 32,609,632
Yearly rate of fuel savings		$391,315,584
Add saving in cost of transporting coal and fuel oil for locomotives		$191,245,020
Combined estimated yearly savings		$582,560,604

I.C.C. statistics show the assignment of locomotives by types and class of service, but do not give information as to the number of locomotives that are active, stored or unserviceable; however, by collating certain known facts it has been possible to make fairly good estimates.

Table 7 shows that the estimated cost of displacing all presently used steam railway locomotives would require a gross capital investment of $3,804,071,000. This gross capital outlay may be offset by certain capital credits, as follows:

Scrap value of 34,731 steam locomotives	$ 119,088,000
Value of 79,097 released freight cars	237,291,000
Offset credit to capital account	$ 356,379,000
Net capital investment	$3,447,692,000

The net capital investment for complete dieselization of Class I railways in the United States would thus be $3,447,692,100. This would be a sizable investment, but consider the time required for the payout. With an annual saving of $582.56 million in just two items—the cost and the transportation of locomotive fuel—an investment of 3,447 million in new diesel locomotives could be paid off in 5.9 years. The railroads would probably have difficulty in attracting that much venture capital, but since the investment is for motive power they could issue equipment certificates, which are the easiest of all securities to float.

Aside from the direct cash savings there would be important indirect advantages. The freeing of 79,097 cars now tied up in the haulage of locomotive fuel would be a large help. Right now the railroads need 12,000 new cars a month. The scrapped steam locomotives would help the steel shortage. The general public would have access to 227,485 more tons of coal per day. The oil situation would be relieved by the substitution of 170,343 barrels of diesel oil per day for 277,485 barrels of fuel oil; that is, instead of producing 100 barrels of fuel oil from a given amount of crude oil, the oil refiners would need to produce only 75 barrels of diesel oil.

Other indirect benefits would come from elimination of the present expensive operation of roundhouses, coal and water stations, etc. Tank facilities for diesel oil would be only 75 per cent of the tankage for fuel oil. Maintenance of roadbed would gain from the fact that the drive wheels of steam locomotives are close together, which means that their weight is concentrated within a relatively short distance, and with their tenders they have nearly as many more non-driving wheels which means extra pounding of the rails. Car repairs would be less. With the relatively large tractive force of diesels at starting, and with properly trained diesel engine men, drawbar pull-outs will decrease. The damage to freight cars from the jerks of steam engines, and damage to freight cargo will involve less expense, and it is even worth while to mention that the rear-end train-crew on a long steam-drawn train will get much less shaking up. No data are available for making an estimate of the cash values of some of these subsidiary benefits, but there is little doubt that they will be considerable.

Another direct saving would result in a decrease of the overtime pay of train crews. For instance, the straight-time pay of a train crew of five men in March, 1948, averaged $6.98 per hour; their pay for overtime averaged $9.84 per hour. When the speed of freight trains averages 25 miles per hour the crews receive a day's wages for four hours work. The step-up of train speeds that is possible with diesel locomotives would have an important bearing on the cost of labor in train operation.

The final conclusion is that it should be very worth while to substitute diesel power for steam power at the earliest practicable date.

The first question then is: Where to begin with the substitution? Should the coal burning steam locomotives or the oil burning locomotives be the first to go?

An answer to this question may be obtained from a further breakdown of the data in Table 6, whereby we obtain the figures in Table 8.

Table 8. Service—unit costs of operating railway engines—March, 1948.

Diesels	Coal Burners	Fuel Oil Burners	Ratios
	Per Switch Engine Hour		
$0.673	$2.284	$3.543	1:3.39:5.26
	Per 1000 Gross Ton Miles		
$0.177	$0.344	$0.468	1:1.9:2.64
	Per Passenger-train Car-miles		
$0.030	$0.054	$0.062	1;1.8:2.06

The information in Table 8 may be supplemented by the data in Table 9.

Table 9. Tons hauled per ton weight of locomotives and tenders in freight service.*—March, 1948.

Kind of Locomotive	Tons Hauled	Ratios
Fuel oil burners	6.74	100.0
Coal burners	7.11	105.0
Diesels	8.69	128.9

*Similar data are not available for passenger service.

The figures in Tables 8 and 9 point to the conclusion that the fuel oil burning locomotives should be the first to go, and they should be followed, with as little delay as possible, by the coal burners. Let's go, railroads.

Table 7. Estimated diesel requirements to replace steam locomotives—March, 1948.

Class of Service	Steam Locomotives Displaced	Diesels to Buy	Equivalent Horsepower (000)	Cost per hp.	Total Cost (000)
Freight	19,644	10,169	26,863	$100	$2,686,363
Passenger	5,169	3,198	5,829	100	582,927
Yard	9,918	5,942	5,942	90	534,780
Total	34,731	19,309	38,635	$ 98	$3,804,071

PAYLOAD CAPACITY

Diesel Tournapull with E16 Scraper.

Caterpillar diesel wheel tractor with LaPlant Choate scraper.

Editor's Note: This article is taken from a Paper entitled "The Relation of Rated Capacity To Pay Yards in Earthmoving Equipment," by D. K. Heiple, Chief Field Engineer, R. G. LeTourneau, Inc., presented at the SAE National Tractor and Diesel Engine Meeting, Milwaukee, Wisc., Sept., 1948.

SUPERFICIALLY, it would seem that the capacity of a scraper or wagon is an easily defined quantity, resulting from a simple mathematical computation involving width, length, and height.

The practical solution of this problem, however, is somewhat different, and, up to the present time, there has been little agreement within the industry as to the correct method of applying or computing a volumetric rating to carrying scrapers. The difficulty results from several causes. First of all, we are not dealing with a closed container, but with an irregular shaped, open topped box in which material may be heaped above the height of the retaining sides. Secondly, the materials being handled have not one—but three volumes; one volume, as it exists in its natural undisturbed state, a second, as it swells or acquires voids when disturbed by loading, and third, a final volume as it is placed and compacted in a new location. The problem is further complicated by the fact that the user is almost always paid for earth movement on the basis of the original undisturbed volume, sometimes on the final compacted volume, but seldom, if ever, on the actual loose volume that is occupied in the scraper itself.

Add to these factors the relative ability of materials to stand or retain a slope, varying from 2 to 1 to ½ to 1, the characteristic of acquired voids which may be all the way from 10% to 50%, and the rated capacity of any scraper is suspect in the eyes of competition.

The problem, as I see it, has always been to present a rating in which struck capacity is as near as possible to an actual true volume as contained by the side sheets, and heaped capacity as a compromise based on the variables of materials in such a manner that an easy rule of thumb conversion will result in a reasonable approximation of the pay yards being carried.

Kenneth F. Park, in his "Principles of Modern Excavation and Equipment," describes such a method. Assuming, for purposes of computing heaped capacity, that all materials will stand on a 1 to 1 slope above the side sheets, he then applies a percentage conversion factor to determine pay load. The percentage factor depends on the material in question, and although it has nearly always been labelled as "swell" or "voids," is actually a composite figure covering roughly both the acquired voids and the ability of earth to stand on a given slope. For instance, with sand, a maximum scraper load is considered on this basis to be 10% less than the heaped rated capacity. It is not felt that sand acquires 10% voids in loading, but probably a much lesser figure, since we also know that it will not ordinarily stand on 1 to 1 slopes. The combination of the two, however, Park tells us, when applied against a heaped capacity based on 1 to 1 slopes, will result in a good approximation of the actual maximum pay load. Conversely, a plastic clay has been given a 30% "void" factor, combining what is believed to be more than 30% voids with an ability to stand on slopes greater than 1 to 1. To topsoil or common earth on the same scale, a factor of 20% has been given. The best feature of this method is the easily remembered progression of 10%, 20% and 30% for the three major divisions of scraper materials — sand, earth and clay. The difficulty arises from the infinite variations in soil characteristics within these three general classifications. Clay, for instance, may contain sand and moisture in varying quantities with voids varying from perhaps 10 to 40 percent. Since earthwork is a series of approximations, however, experience has made it possible to make some common sense adjustments for individual jobs without seemingly creating serious errors.

Precise estimates with such methods are not considered possible, and should one occur, would appear to be more luck than good shooting. It is necessary to recognize that these differences in soils exist, but once recognized, I would generally say that the accuracy of the method can be kept in line with overall accuracy and efficiency of dirt work in progress, subject to final adjustment upon completion.

Although the information accumulated by Park has been in printed form for some six years at least, it is not my experience that it is widely known or used in the industry beyond the LeTourneau and Caterpillar Companies.

Beyond the method outlined by Park, there is to my knowledge no definite approach to a system of estimating pay yards in relation to material to be handled. There has been some use of struck yardage rating for pay load, but, in light of the previous discussion, I believe the inaccuracies of

OF DIESEL EARTHMOVERS

By D. K. HEIPLE

International diesel TD 24 with Carryall Scraper.

such a procedure are obvious. Many contractors, of course, with long experience operating several models of scrapers, in not too similar conditions, have acquired a phenomenal knowledge of their ability, based probably on load count against engineers cross sections. This individual knowledge, of course, can not be classed as a computing method, although it could certainly be applied to development of one if properly evaluated.

Up to this point, we have not considered another highly important factor, which is simply the available loading power from tractors or rubber-tired hauling and pushing units. All pay loads have been considered as maximum, which may or may not be the case, depending on power required to load.

Within the industry, however, with all its use of cubic yard measure and cubic yard rate of pay, the final analysis on competitive test has always been a weight check. A cubic yard in place may occupy one and two-tenths cubic yards in the scraper, but a pound of dirt remains a pound of dirt. With this in mind, we have checked the weight of scraper load against the weight of in-place material on several jobs during the current and past dirt season. Most of the equipment was our own, some competitive. The sum total of information now at hand is still in sufficient to graph or chart a fixed relationship. Perhaps a new trend is indicated, although for myself the information can be used to strengthen or confuse present thinking, depending on the approach. I want to give you a few of the weight test results with as little personal comment as possible.

On one job, a series of ten loads were weighed with a Tournapull having a rated capacity of 30 cubic yards working in sandy clay. Average net load was 56,990 pounds. An accurate sample of in place dirt was weighed to establish a weight of 2,816 pounds per cubic yards.

$$\frac{56{,}990}{2{,}816} = 20.2 \text{ Cubic Yards} - \text{Pay Load}$$

Using a void factor of 30% for clay (in this case actually sandy clay) our estimate would have shown:

30 Cubic Yards − (30% × 30) = 21 Cubic Yards

Another weight check under different conditions gave the following results. This time wet sticky clay was being loaded into two machines rated at 13.3 and 15 cubic yards heaped.

	13.3 Cubic Yard Machine	15 Cubic Yard Machine
Aver. Weight of Load	27,380#	24,500#
Weight of Material in Place	3,028# per Cu. Yd.	3,028# per Cu Yd.
Pay Yards per Load	9.04	8.1
Again a 30% void Factor in Clay would give an estimated Maximum Load of	9.32 Cu. Yd.	10.5 Cu. Yd.

Our engineer in this case reported tires on the Tournapull as being worn smooth, and therefore adding very little to the loading power in a wet pit following two days of intermittent rain.

A second job with the same units in sand resulted in these weights:

	13.3 Cubic Yard Machine	15 Cubic Yard Machine
Aver. Weight	29,112#	32,270#
Weight of Material in Place	3,160#	3,160#
Pay Yards per Load	9.2	10.2
Max. Load Weight	33,600#	34,300#
Max. Pay Load	10.6 Cu. Yd.	10.85 Cu. Yd.
A 10% void factor would give an Estimated Maximum Load of	11.9 Cu. Yd.	13.5 Cu. Yd.

Some check has also been made into loads carried by different models of wagons:

	27 Cu. Yd. Unit	14.7 Cu. Yd. (on 3 to 1 Slope)
White Sand (2,650# per Cu. Yd.)	71,600#-27 Cu. Yd.	36,700#-13.9 Cu. Yd.
Red Sand and Gravel (2,650# per Cu. Yd.)	78,900#-26.3 Cu. Yd.	46,600#-14.9 Cu. Yd.
Silty Topsoil (3,100# per Cu. Yd.)	69,000#-22.3 Cu. Yd.	

With the 27 cubic yard unit in sand or sand and gravel, the maximum pay load should be 90% × 27 = 24.3 cubic yards. In topsoil, maximum load should be 80% × 27 = 21.6. The capacity of 14.7 cubic yards on a 3 to 1 slope, of course, is not theoretically reducible by this method. In conducting an experiment of this kind to draw any real relationship between pay yards and rated capacity, we must have actual capacity loads. Dirt spilling over the back or sides is a simple visual check. On the other hand, capacity or near capacity loads may result without spillage. Then it is necessary to work the problem backwards, assuming first that the expected computed load is correct.

Here, again, we make use of Ken Park's "Principles of Modern Excavation and Equipment," for a simple rule that a pound of drawbar will load a pound of dirt. Checking our first weight in this manner would indicate nearly correct results, since 56,000 to 57,000 pounds would be the maximum available drawbar power from pushing tractor and Tournapull combined at the point of measured load.

In the second instance, some 40,000 pounds of drawbar being in excess of requirements with the smaller machine, managed to fill it in spite of a wet pit. The effect of smooth tires is evident on the larger unit.

On our third, weights and estimated load would indicate the need for 37,600 to 42,700 pounds of drawbar for a full scraper. This should have been available as in the previous instance, since the same equipment was used. Traction, operator technique or basic assumption, however, introduces a considerable variation on this one.

The 28 cubic yard pay loads, which defied analysis before, show up in a different light when approached in this manner.

Pay load is something less than this rated capacity. Given sufficient loading power, it is somewhere in the neighborhood of 90%, 80% and 70%, of rated capacity for the three major divisions of scraper materials, sand, earth, and clay.

INTERNATIONAL TD-24

One of the first TD-24's in Georgia goes to work on the Clark Hill Dam on the Savannah River. The new dam will create a 78,500 acre reservoir.

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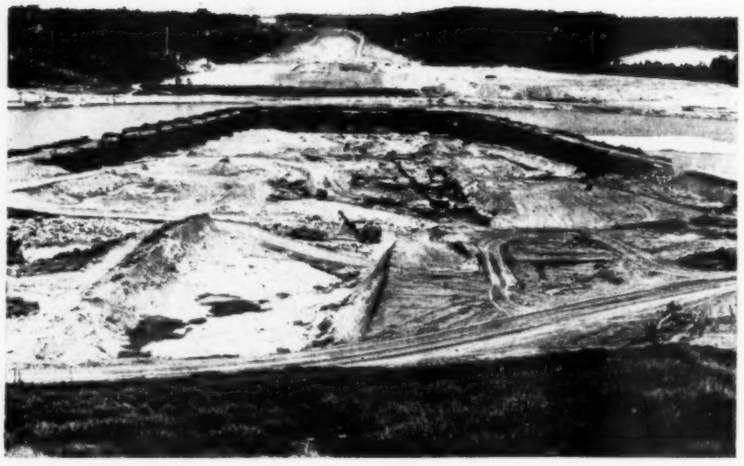
(Right) View of Clark Hill Damsite. This is the first major project for the development of the Savannah River basin.



Perry Const of Scranton,
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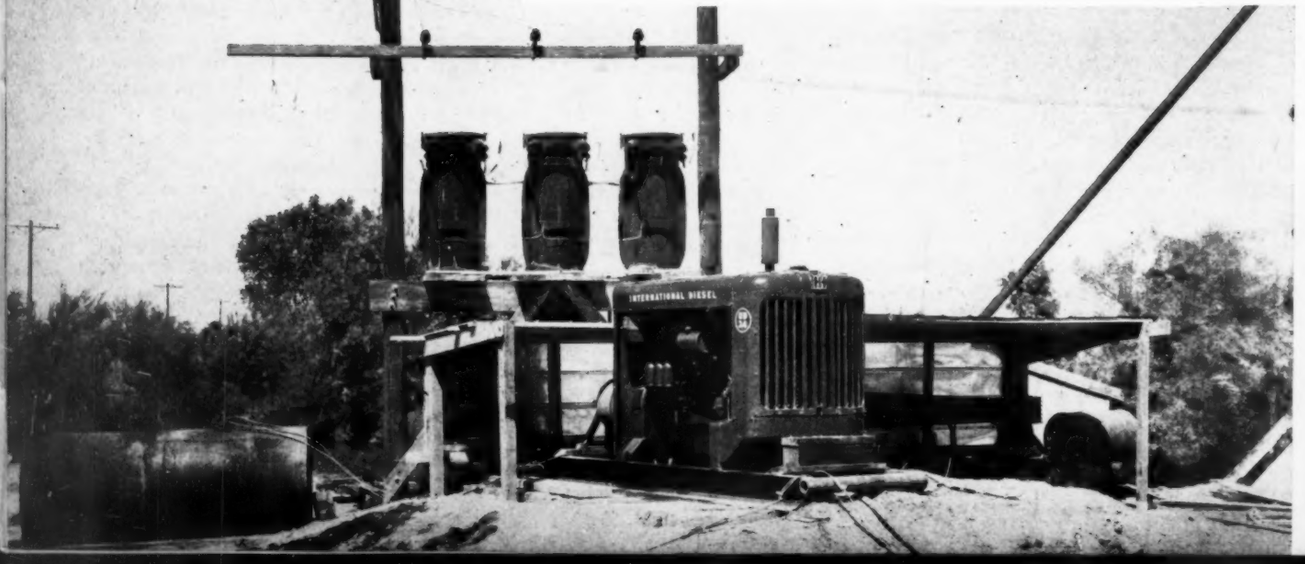
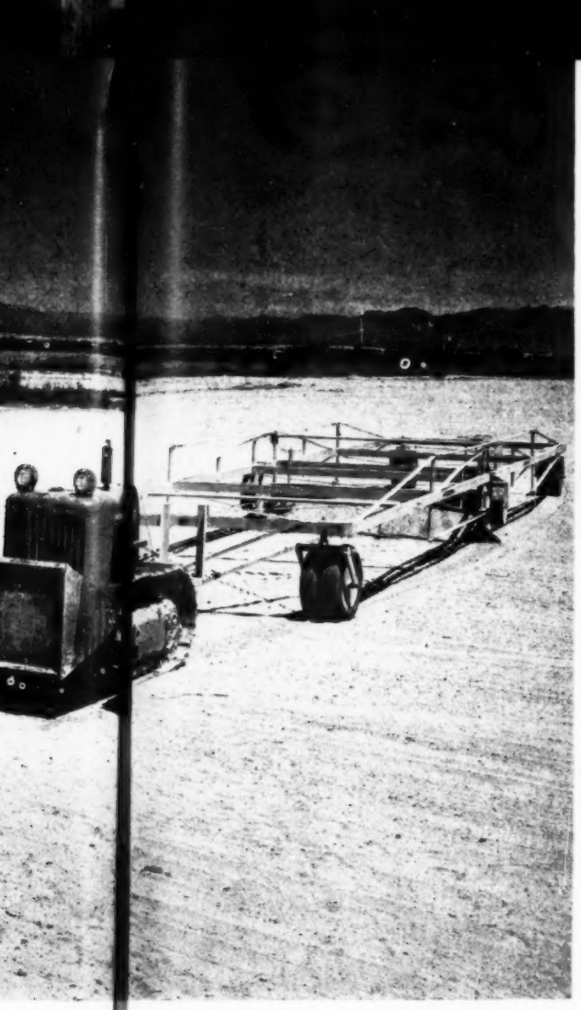
International UD-24 power unit in service in Arizona pumping water for 400 acres of farm land at a rate of 2400 gallons per minute.



GOES TO WORK



Land leveling in preparing new land for irrigation here in California's Imperial, owned by Larry Lambertz, handles a Marvin blade measuring 80 x 17 feet.

In the Warrior Coal Basin near Birmingham one of two recently purchased International TD-24's goes to work for Calvert and Youngblood stripping coal from the Black Creek seam.

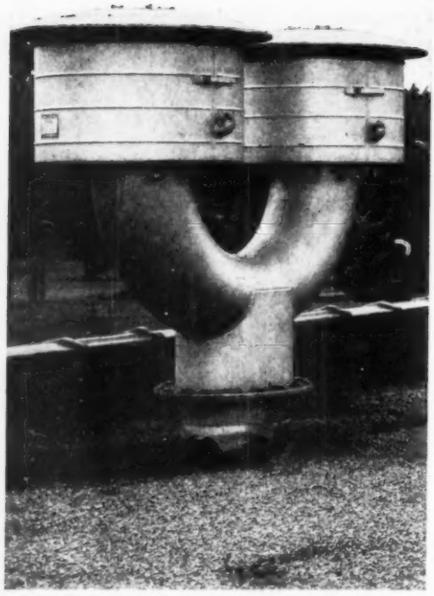
(Below) At work on a 3½-mile roadbuilding job, International TD-24 hauls a big wheel scraper. J. R. Cianchette of Pittsfield, Maine owns the equipment on the job.

In Georgia its the same story with a TD-24 doing some fast dirt moving on a highway job near Norcross. Rutland Construction Co. recently purchased this new equipment.

Perry Contr. of Scranton, Pa. uses this TD-18 with a 14-foot Isaacson bu anthracite stripping job near Throop where 14-foot coal veins come to the surface.

Oberlin's Opposed Piston Diesel

By BRUCE C. SISSON



Twin Air-Maze intake silencer for new diesel is mounted on roof of Oberlin plant.

HOW does a modern high speed opposed piston diesel fit into the power picture in a middle aged diesel plant. According to Superintendent Frank E. Craig of the Oberlin municipal power plant it fits in perfectly.

In the February issue of DIESEL PROGRESS the Oberlin plant was discussed at length. The remarkable 14-year operating record was cited to show that since 1934, four diesels have produced 58,564,200 kw. hrs. and that these diesels had accumulated a total of 150,471 engine hours. Moreover the plant produced 11.98 kw. hrs. per gallon of fuel during the entire period. There has been only one outage which caused the plant to drop its load and that lasted only ten minutes. All in all the Oberlin plant has been very successful both mechanically and financially for at the end of 14 years the $262,900.43 power plant was completely paid for and a clear net profit of $107,464.05 showed on the books.

As towns grow, so must their power plants and in the fall of 1947 it was decided that a new diesel was required to supplement the four Fairbanks Morse engines already in service. These included one 600 hp., 400 rpm.; two 875 hp., 300 rpm. and one 1400 hp. 300 rpm. diesel.

Inasmuch as the Fairbanks-Morse opposed piston engine was then in volume production and was offered with the same basic guarantee as the slower speed Fairbanks-Morse engines, the Oberlin town fathers decided to buy the opposed piston diesel rather than wait six months or more for a slower speed engine.

The new 1600 hp. diesel began operating in January 1948. It is equipped with a 1420 kva., 1136 kw. Fairbanks-Morse generator and a F-M 125 volt, 15 kw. exciter. Both turn at engine speed—720 rpm.

Located in the new wing of the plant, the new diesel is easily accessible from all angles and stands resplendent in its coat of light paint, compared to the more conservatively hued companion engines which having served long and faithfully are content with relative obscurity. The O-P diesel presents them with a challenge they only half realize at present.

As with any new installation there have been "bugs" to iron out. The O-P had a tendency to give out a few more decibels of sound than was thought proper by nearby residents and as a result several modifications were made in the intake air piping arrangements. The pressure charging blower had an annoying whine. The installation of two Airmaze units—one on the air intake and one directly above the blower housing in the air intake line licked the intake silencing problem. Presently the exhaust system is being modified to trap the remaining exhaust noises. The performance of the new diesel has been good with excellent fuel and lube consumption figures for the first six-month period. Tentative averages for this period show energy production at the rate of 13.16 kw. hrs. per gallon of fuel and a lube oil consumption rate of one gallon for every 2039 kw. hr. Both these tentative figures show economy well above the plant average of 11.98 kw. hr. per gallon of fuel and 909 kw. hr. per gallon of lube.

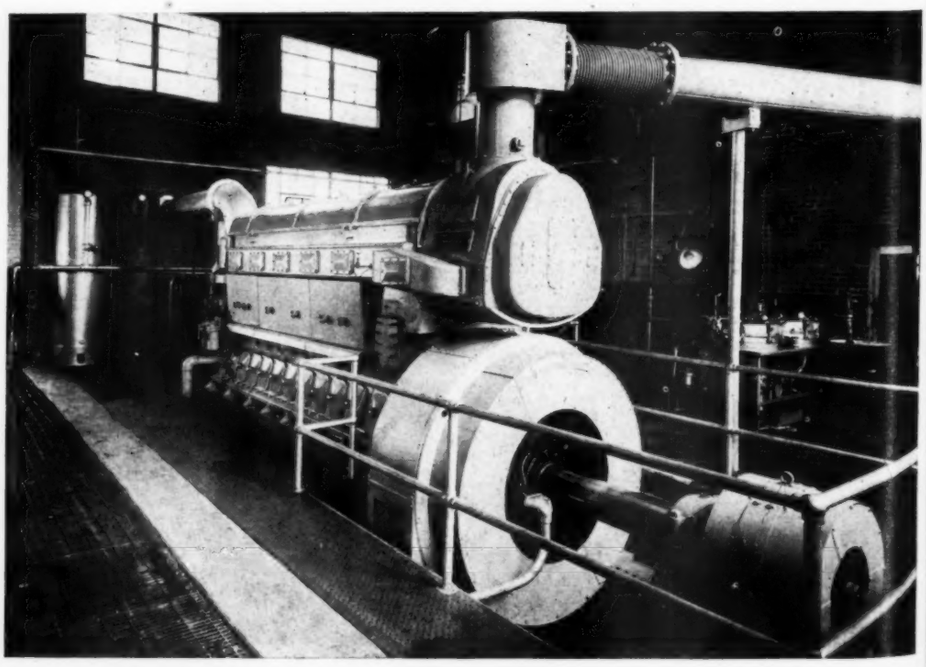
The new engine is equipped with a woodward governor. A duplex Nugent fuel oil filter handles fuel oil to the engine pump. Alnor pyrometers are installed. At the basement level a 5 unit Hilco lube oil filter is installed which operated on a bypass system. A Nugent bag type filter is also installed for continuous filtration. The jacket water cooler is a Schutte and Koerting shell and tube job and the lube oil cooler is of Ross Heater Manufacture. Temperature control of cooling water is by a Fulton Sylphon valve. Superintendent Craig runs his cooling water into the engine at 140° F. It leaves the engine at 150° F. Lube oil temperatures are 135° F. to the engine and 150° F. out. The Fulton-Sylphon regulating valve holds these temperatures constant. The oil pump is a Roper which delivers oil to the engine at 35 lbs. per sq. inch.

Cooling water for the new diesel is treated with Nalco compound which has been found to be very effective in preventing engine jacket scale. The cooling tower is kept in good condition through the use of a Haering water softener.

Superintendent Craig uses Marathon naphthenic base lube oil and Standard of Ohio's #3 fuel oil. A Liquidometer tank gauge is installed to the operator's benefit.

The new diesel can carry the town's requirements alone during the daylight hours of the summer. This factor has permitted the plant personnel to go ahead with its 8,000 hour overhaul period for the remaining 4 diesels. So far the inspection has revealed the engines to be in good shape and with a change of rings and other minor repairs the old timers will be ready to begin their second 14 years. But this time they will have the 1600 opposed piston diesel to help them along.

1600 hp opposed piston Fairbanks-Morse diesel at Oberlin municipal plant. Air-Maze auxiliary silencer seen over blower at top of picture. Hilco lube oil reclaimer (right). Nugent fuel filters mounted on engine (left).



Fleet of 30 Peterbilt Tractors with 200-hp Cummins Diesel engines and 38 cu. yd. Southwest bottom dump wagons.

AIRPORT CONSTRUCTION ACROSS THE COUNTRY

37 MILLION DOLLAR PROJECT IN SAN FRANCISCO

By FRED M. BURT

In the construction of additions to the San Francisco Airport, leading to an ultimate 4,000 acre, $37,000,000 airport, one of the biggest jobs has been the moving of millions of cubic yards of earth to fill in hundreds of acres of marshy tract bordering San Francisco Bay, and making fills in the shallow waters of the bay itself. When completed, this will be one of the finest and largest airports in the world.

After having made a 160 acre fill in 1944, co-bidders Macco Construction Co. of San Francisco and the Morrison-Knudsen, Inc, of Boise, Idaho, received another contract in 1946, to make an additional 240 acre fill, further extending the airport into the bay.

It was necessary to find, close at hand, millions of cubic yards of dirt to make the fill, and then to deliver the earth. Macco-M-K, simply acquired a mountain three miles west of the airport and not far from Skyline Boulevard. Then they erected three heavy-duty overpasses above two main highways and a railroad as part of a $300,000 access road to the airport.

Using this high-level, high-speed road, the earthmoving pace set was breathtaking. Operating three seven hour shifts, seven days a week, under sun and electric lights, every 26 seconds, a heaped truck load left the pit and an empty returned. The principal earth-moving units were 30 Southwest EW-30 Bottom Dump Wagons transported by big Peterbilt tractors powered with 200-hp. Cummins diesel engines.

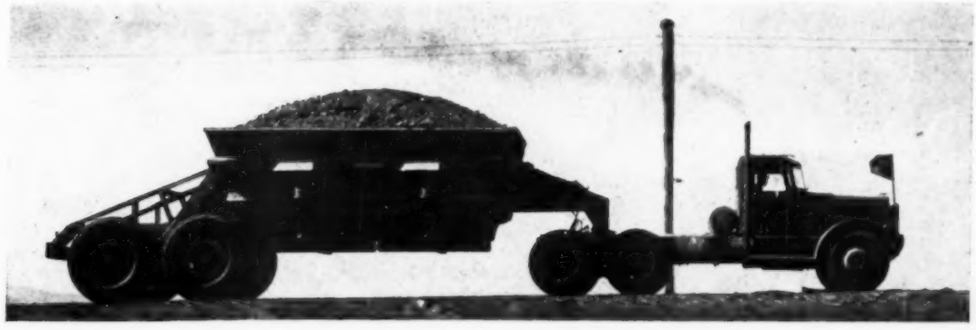
These 35-ft. long, bottom dump trailers, with net weight of 30,000 pounds and a heaped capacity of 38-cubic yards, along with the big Peterbilts, are rated as the largest of their kind ever built. And to bring the story along into 1948, these same trailer-tractor, earth-moving units, after having carried millions of cubic yards of earth from pit to fill on the first contracts were subsequently purchased by the Guy F. Atkinson Co. of San Francisco to be used similarly, to fulfill a later contract obtained by them.

On the loading end, working against a benched pit wall about 260 feet high, three Bucyrus-Erie electric shovels with six yard scoops, dumped eight tons of dirth into the trailers at each bite. Nearby three Northwest shovels with 2½ yard buckets, swung their loads into the trailers. Diesel-engined dozers worked the benches in the pit, usually at the 200 foot level.

Caterpillar diesel tractors and dozers also worked on the fills, pushed muck, built levees against tides, pulled a Southwest rubber-wheeled roller carrying a 100 ton load, and did all sorts of grading work.

Throughout all phases and contracts of this airport construction project, in the past, present, and until completed, the chief factors in all the movements of earth and allied operations, are diesel units.

Peterbilt Diesel tractor speeding 38 cu. yd. load of earth from pit to fill.



Caterpillar D7 with a LeTourneau blade levelling off a fill at Baltimore's Friendship Airport.

Friendship International Airport at Baltimore

By JOHN W. ORRSON

A CAREFUL program of engine maintenance has kept diesel-powered units of earth moving equipment on the massive job of constructing the new Friendship International Airport of the City of Baltimore near the southwestern suburb of Linthicum Heights without any major mechanical interruption.

Potent Caterpillars, Internationals, G.M.C.'s, Cummins and other Diesels in tractors, Tournapulls, Terracobras and shovels purr like satisfied kittens since work began on this new aeronautical harbor in May of 1947. The initial work was executed by two Caterpillar D8 bulldozers as they comenced clearing the wooded section of the 2,500 acre tract of rolling terrain.

As work progressed, extra duty was forced upon the Diesel equipment to recover valuable time, lost by a comparatively hard Maryland winter. But despite the long shifts of labor with most units at one time or another pulling daily shifts of 20 hours each without let-up, no serious trouble had been encountered by the Diesel maintenance crews of C. J. Lengenfelder and Son, Inc., of Baltimore, general contractors for this project.

The seasoned mechanics under the personal direction of Gil Allen, the company's able Superintendent of Equipment, religiously follow his credo: "An ounce of prevention is worth a pound of cure."

With more than 60 pieces of equipment, digging their talons into the soft sandy clay earth to carve out runways and taxi strips for this airway haven which will be used in conjunction with the present but distant Baltimore Municipal Airport, the close scrutiny of these Diesel implements has kept the cost of operations at a minimum.

The nerve center of the maintenance department for this project is housed in a temporary 40 by 100 foot wooden structure near the focal point of operations. It is fully equipped to handle any type of job from griding valves to a major overhaul. Included in its equipment is a Yale 5-ton chain fall, welding outfits and a spare part department for all pieces of machinery and engines.

Its skillfully trained personnel embraces three shop mechanics with two helpers on each day and night shift which are supplemented by another six men who comprise the field crew on these two shifts. It is a sizeable operation.

Aided by two grease trucks and one fuel oil tank car, this combined team is the sentinel over the diesel power, laboring on the airport location, ever-watchful for symptoms of mechanical trouble and delay as the element of time and equipment efficiency are highly important to a contractor doing a good job.

The Diesel-powered charges of the maintenance department C. J. Langenfelder & Sons, Inc., one of the largest contractors on the East Coast, vary from small Caterpillar tractors to giant Wooldridge Terracobras, powered with Cummins 150 h.p. engines, used for grading and intermediate hauls. The only gasoline-fired vehicles or equipment used on the job are a few trucks to carry supplies to the field and jeeps for inspection purposes.

The starting measure of this huge earth-moving project to mold the geometric lines of the architect's blueprints out of farmland for a modern airport was relegated to the two Caterpillar D8 bulldozers to clear designated tracts of trees,

A Cummins-powered Woolridge Terracobra loading sandy soil is aided by an Allis Chalmers bulldozer equipped with G-M diesel.

Asphalt plant on location at airport site is powered by Caterpillar diesel generating set at right.

brushes and heavy growth of foliage in the area.

They were followed and assisted by two Lorain, Model 82, shovels with revised 2.7-yard buckets and 11 rubber-tired bottom-dump Euclids, powered with G.M.C.'s Series 671 Diesels, which were regimented for long hauls. The Lorain shovels used 160 h.p. Waukesha straight and 160 h.p. Waukesha-Hesselmann Diesels, respectively.

Working in the sandy soil of Anne Arundel county with heavy rubber-tired equipment is not termed as child's play by members of the contracting fraternity. Deep layers of sand intermingled with runs of clay play havoc with smooth-running equipment and entails greater work, both from the points of maintenance and actual labor. More traction apparatus is needed to come to the aid of the heavier types, straddled down in pits of soft sand.

With this condition existing ,additional equipment is being used in the long phase of grading and paving runways and taxi-strips. The grading aspect of the contract involves a hard and extended task, especially in the hilly terrain where the maximum cut was up to 25 feet. It also entails the shifting of top soil and sand from a cut to a store pile and re-hauling it back to replace excavations of clay, to fill depressions, or to grade slopes on the airport's surface.

In the process of grading and filling, the contractors rely upon a large array of diesel equipment. It includes 13 Super C. Tournapulls and three Terracobras, each powered by 150 h.p. Cummins, for hauls of intermediate distance, and 11 Le Tourneau scoops, drawn by Allis-Chalmers', HD14C, HD19, and Caterpillar D8 tractors. The latter pieces are user for short hauls.

Supplementing these pieces of earth-moving machinery are batteries of five Caterpillar D8 snatch tractors with Tournapulls, three International TD18 push cat tractors, seven Caterpillar D7 bulldozers, three International TD18 bulldozers, one Allis-Chalmers HR19 bulldozer, and five Caterpillar DW10 units used for stripping the top soil and replacing it on the slopes.

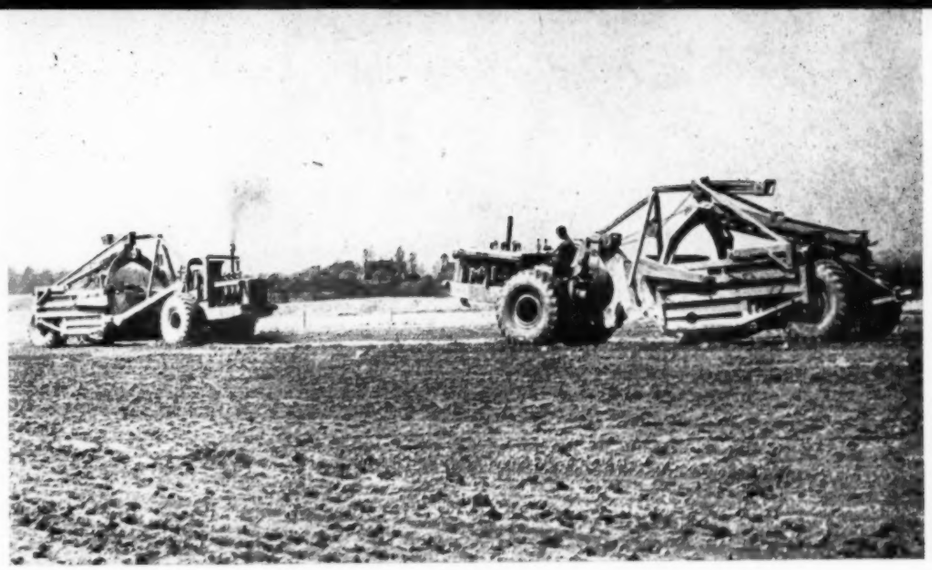
Two more Allis-Chalmers, tractors, type HD19, with G.M.C. Diesel engines, have the massive duty of pulling the immense 150-ton compaction roller, one of the three ever built universally. This roller which is employed as a sub-grade tester uses 60-ply tires, eight feet in diameter and with the tube, each weigh one ton.

"With all this equipment used on this contract," drawled Mr. Allen, "you can see that our department is kept alert. We always keep abreast of the situation and try to nip the trouble in the bud."

He added:

"This policy of anticipation has saved a lot of equipment from being bogged down in our repair shop. Our main opposition here is the heavy amount of sand on the airport site. Sand, as you know, is very abrasive and plagues the tracks on the tractors. We have to replace track pins, bushings and sprockets about every 800 hours of work where on any other location, they would ordinarily run the regular 2,000 hours.

"Loose sand also means poor traction and this is very detrimental to the rubber tired equipment. It is nothing for our heavy equipment to sink several feet in a soft spot in the sand. This is another point of contention. But despite all these adversities, we haven't had any serious reversals from the Diesel engines.



Two Tournapulls, equipped with Cummins diesels approach each other. One is loaded, one is not.

"Our diesel engines have been functioning efficiently and consistently. As an example of this statement, we worked 18 pieces of equipment, powered by G.M.C.'s Series 671 diesels, regularly for daily shifts of 20 hours for a nine-month period and at the end of that time, only four came into our shop for overhaul. Considering the adverse conditions of sand, and sand dust storms, we think this is a good showing. Our other makes of Diesels have also stood up magnificently under this uncheduled test of stamina."

However, these satisfactory performances had the benefit of the Langenfelder maintenance policy which has successfully curtailed engine break-downs. Its rules are elementary and based on prevention.

At the beginning of every shift, all the equipment, including the Diesel engines and accessories are carefully inspected for possible sources of disturbances. The panel boards are kept under a close scrutiny by the operators and mechanics alike. Oil pressure, oil consumption and fuel lines are under a constant vigil.

Two grease trucks, plying from location to location, are under orders to grease the complete array of working equipment every 10 hours of operation. Dryden grease is used on the tractor rollers while D-A grease is employed in transmission and in other lubricated joints.

Perfectly aware that proper lubrication lengthens the life of the apparatus, Mr. Allen has decreed that lube oil and lube oil filters are changed every 100 hours of labor. Standard Oil's HD lube oil is used and Standard's diesel oil are used exclusively by the Langenfelder firm on this project at present.

Although some diesel operators change types of lube oil filter cartridges, Mr. Allen follows the procedure of adhering to the manufacturer's standard accessory. On the Cummins engines, DeLuxe and Nugent filters are employed while on the G.M.C.'s and Euclids, AC and DeLuxe are standard, respectively.

Working in the dusty atmosphere, the air filters on the diesel are cleaned daily and fuel lines are kept clean. New cartridges are installed in the fuel oil filters every 30 days and once again, the mechanics follow the manufacturers' recommendation. After a 90 day period, diesel engine valves are checked and if needed they are brought up to specification.

The winter months is the time devoted to major overhauls. Before the engine is completely disassembled, it is exposed to a thorough steam cleaning. This is another method of prevention. The cleansing washes away any harmful abrasive or foreign particles which might fall in the working mechanism of the equipment.

The equipment is refueled out on the field. The contractor maintains a fuel truck which has a capacity of 1,000 gallons of fuel oil. The fuel truck receives its supply from an 8,000 gallon storage tank, sunk below the ground, just outside the maintenance building.

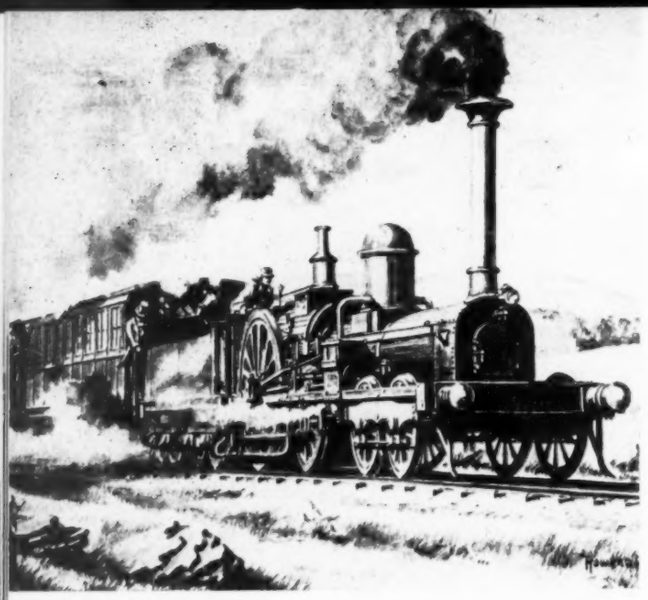
This careful system of maintenance of the diesel engines, pulling various types of earth-moving equipment, has enabled the contractor to keep up his schedule and for the first nine months of operations approximately 6,500,000 cubic yards of dirt have been moved. This comprises a daily average of 50,000 yards for a 20-hour shift.

Although the Langenfelder firm holds the major contracts for clearing, grading, paving and installing the drainage system for the new Baltimore airport, some of the work has been sub-contracted. The sub-contractors also depend on diesel energy to fulfill their agreement to the general contractor. A Bay City ¾-yard back hoe, powered by a Caterpillar 4600 diesel, is among the shovels digging trenches for the drainage network.

Asphalt which will be poured on the runways and taxi-strips in the final stages of the contract is manufactured on the airport location, saving time and distance. An asphalt plant has been constructed and furnishes its products under the top capacity of 100 tons per hour. Supplying this plant with exclusive power is a sturdy Caterpillar D17000 diesel generating set which transmits energy to the electric motor.

With the completion of this project, it will give the industry and citizens of Baltimore one of the finest airports on the East Coast and an up-to-date haven for the nation's transcontinental and divisional airlines.

And, once again, diesel engines through a careful maintenance program have contributed constant might to help fulfill a city's plan to maintain its position in airway travel.



"Lightning" first locomotive built by the company at Schenectady in 1848.

AMERICAN LOCOMOTIVE COMPANY CELEBRATES 100th ANNIVERSARY

THE hundredth anniversary of the American Locomotive Company plant was observed at Schenectady last month. After a hundred years as a dominant builder of steam locomotives, Alco is now completely out of the steam business, its vast 112-acre installation converted 100 per cent to the manufacture of diesel-electric locomotives.

Alco, one of the Big Two in the diesel locomotive industry today, is currently doing 40 per cent of the diesel-electric business in the nation.

With production still climbing upward, Alco's 6,500 employees paused only briefly to observe the Centennial. At noon on Sept. 24, on behalf of its employees, the company presented a 110-ft. flagpole to the City of Schenectady in honor of the memory of the community's war dead.

Later a plaque, commemorating the Centennial, was erected on Alco's executive office building by the Schenectady Chamber of Commerce.

On Saturday all employees and their families were guests at a day-long Open House program at the plant. Models of early locomotives and the real thing in the form of a modern diesel-electrics were displayed, as well as paintings, historical documents and other displays.

Turning back the pages of history, Platt Potter and John Ellis joined other progressive citizens in 1847 in investigating the possibility of establishing at Schenectady a big locomotive manufacturing works. They invited the Norris Brothers of Philadelphia, to help set up the plant.

Edward Septimus Norris, together with his inventor-brother, William, estimated that $50,000 capital would be necessary.

At the beginning the plant was named the Schenectady Locomotive Engine Manufactory, and in 1851 became the Schenectady Locomotive Works.

A little more than a year after the first meetings, the famous "Lightning" locomotive rolled out of the shops. The "Lightning" weighed about 15 tons, had 84-in. drivers. Although rated to haul nine cars at from nine to 15 miles an hour, it is recorded that she once pulled an eight-car train at 80 miles an hour.

Although he had had no previous experience in building locomotives, a lack shared by his associates, John Ellis assumed the lead at the revived locomotive works. Ellis was a cautious and talented Scotsman with an unusual ability to select capable assistants. One of these was an ingenious master mechanic, Walter McQueen, who was appointed chief engineer at the works in 1852. He later became mechanical engineer and also served as a vice president until his death.

During his forty-one years at the works, Mr. McQueen gained a reputation as an outstanding designer and builder of locomotives. For many years, in fact, the Schenectady-built locomotives were known as the "McQueen Engine."

By 1854 the goal of building a locomotive in eight days was achieved, then bettered. The following year thirty-seven $10,000 locomotives were completed.

Then came the Civil War. John Ellis, with eight co-trustees, formed a new company under the same name in July, 1861. They made a bold move, beginning construction of a large number of locomotives without any orders on the books.

Within a few months the Federal government bought all locomotives on hand. The plant, known as the "Big Shop," operated at peak capacity during the war, completing 84 locomotives between 1861 and 1863. In May 1869 the historic locomotive "Jupiter" was completed and its first assignment was to take Ex-Governor Stanford and his party from Sacramento to a point where the rails of the Central Pacific and Union Pacific Railroads meet. Schenectady's historic records state that this locomotive was the first to pass over the rails of these two famous roads.

On June 24, 1901, the Schenectady Locomotive Works became the backbone of today's American Locomotive Company.

The "Big Shop" was merged with seven other companies. The growth of the Schenectady plant continued under its new corporate banner. In 1907 it set another production record by building 942 locomotives with a working force of 6,200. Locomotives then cost approximately $20,000. The technical development of the steam locomotive now rapidly moved toward its all-time peak in the refinement of the Mallet type of articulated locomotives.

Despite the trend to diesel-electric and because of government needs in World War II, the all-time annual production peak in steam locomotive was not reached until 1944, when 1,354 were built. All told, as the end of steam locomotive production came to Schenectady in 1948, the American Locomotive Company and its component plants built more than 75,000 steam locomotives alone.

The trend to diesel-electrics was evident as far back as 1924 when pioneering men at Alco produced the first successful diesel-electric locomotive for railroad use. It still sees daily service at the Bronx Terminal of the Central Railroad of N. J.

Great advances in the development of the diesel electric locomotive, important to the present growth of Alco, were made during the period from 1925 to 1931. The plant manager at Schenectady during this period was Robert B. McColl, now president of American Locomotive. Alco recognized the need for diesel engine equipment and to this end the McIntosh and Seymour plant at Auburn, N. Y., was purchased in 1929.

Alco continued its line of straight locomotive development and in 1929 built the first diesel electric passenger locomotive, a revolutionary unit for the New York Central Railroad.

Back in 1935, Alco and GE engineers undertook the development of a 4-cycle engine with enough horsepower so that one engine per locomotive unit would be sufficient. This engine development was interrupted by World War II when the government directed that the company limit its diesel engine activities to power for switching locomotives, submarines and mine sweepers. It was carried out successfully, however, after the war and the 4-cycle, 12 cylinder, V-type, 1,500 hp. turbo-supercharged engine for freight service and the 4-cycle, 16 cylinder, V-type 2,000 hp. engine for passenger service were produced in 1945 and 1946. During World War II, Alco produced 1,080 steam locomotives and 157 diesel-electric locomotives for the War Department.

Turning to the long, problem-laden march back to peace-time production and commerce, the American Locomotive Company faced the enormous problems of plant reconversion, plant expansion, material shortages, rising costs, maximum employment and, of course, stiff competition for business in an economic market. To solve these prob-

View of American Locomotive Company plant which occupies 112 acres at Schenectady, New York.

lems more than $20,000,000 in company funds were appropriated to effect the conversion to the manufacture of diesel-electric locomotives.

That this uphill fight was won is best indicated by the fact that in 1946 approximately 75 per cent of locomotive production was for steam locomotives and only 25 per cent for diesel-electrics. This ratio was reversed in 1947 as the railroads, their equipment depleted by a war transportation record that shattered all conception of what could be done with rolling stock, wanted diesel-electric locomotive replacements as fast as possible.

More than a billion dollars worth of diesel-electric locomotives will be built at the American Locomotive Company plant in the next ten years, it was predicted recently by Robert B. McColl.

"The overwhelming trend to dieselization of the nation's railroads is even greater than we thought it would be at the end of the war. It will take approximately 20,000 diesel-electric locomotives in the next ten years to replace the 35,000 steam units now in operation in the United States," Mr. McColl stated.

In addition, Mr. McColl revealed that full dieselization of all U. S. railroads would result in less fuel oil being used by locomotives than is consumed today. He pointed out that approximately 7,000 of the existing 35,000 steam locomotives are oil burners. On the average an oil-burning steam locomotive uses many times more oil than a diesel-electric. Currently a total of 227,485 barrels of fuel oil are consumed daily by U. S. railroads. With complete dieselization only 170,343 barrels of diesel oil would be required.

"Dieselization of all Class I railroads," Mr. McColl continued, "will also result in annual savings of more than a half billion dollars from just one item alone—the cost of fuel and its transport.

Mr. McColl pointed to the growing world market for diesel-electric equipment. "Everywhere our representatives go in foreign countries there is a new and lively interest in the tremendous economies being realized by U. S. railroads by the use of diesel-electrics.

One of the latest 6000 hp diesel electric passenger locomotives built by American Locomotive. Production is now 100% diesel locomotives.

INDIANAPOLIS BUSES GOING DIESEL

One of the 25 new General Motors Motor Coaches recently delivered to the Indianapolis Railways.

By C. W. SWIGER

SINCE the spring of 1945 Indianapolis Railways has added 120 General Motors diesel motor coaches to its transit system, establishing a pattern for probable future expansion and at the same time Indianapolis the finest available facilities. Now operating a total of 496 vehicles, including motor coaches, trackless trolleys and street cars, Indianapolis Railways is entering the third quarter of the second improvement program since 1932. With another million dollars yet to spend, completion of this program will give Indianapolis a public transportation system fully adequate for the city's needs.

Street railway service was inaugurated in Indianapolis on October 3, 1864, with mule-drawn cars. The first electric cars were placed in operation June 18, 1890, and in 1894 the entire system had been converted for electric vehicles. Through these early years the street railway system progressed. Good equipment and service brought adequate patronage. During World War I, however, many factors, including high prices and automotive competition, resulted in a heavy loss of patronage. In the post war years there was no money with which to buy equipment and conditions grew steadily worse. By 1930 these forces, and obsolescence had almost engulfed the company and put it on the rocks.

In 1932, at a time when public transportation in the city was at its lowest ebb, Indianapolis launched a 10-year improvement program calling for the expenditure of $9,000,000. It was completed in six years! Under this program the company bought the most modern vehicles then available, introduced the trackless trolley to Indianapolis, installed miles of new track and overhead trolley wires. New maintenance buildings also were constructed.

World War II again made it extremely difficult to obtain new equipment, but at the same time patronage rose to a new high level and constantly increasing demand was placed on the rolling stock then in use. As a result, by 1945, it was apparent that many transit vehicles must be replaced if the service was to be maintained at a satisfactory level; and so, a second improvement program, this one calling for an expenditure of $4,000,000 was initiated in that year.

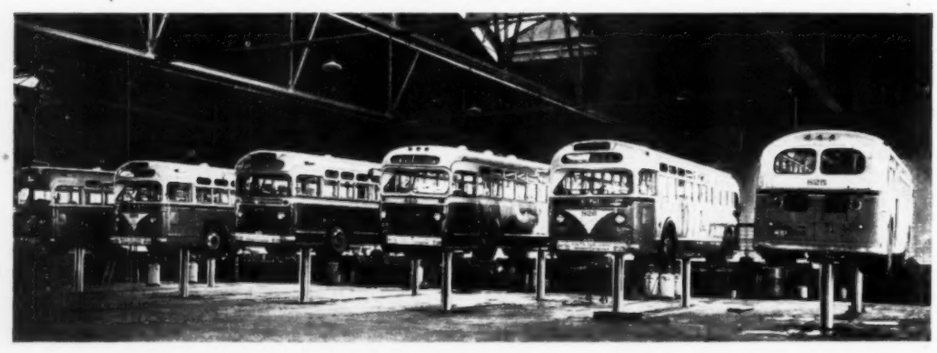
Fifteen new General Motors diesel motor coaches were bought in 1945. They were Indianapolis Railways' first diesels, and their purchase was made not so much through preference as because they were available when needed. But the diesel coaches gave such excellent satisfaction that in 1946, when 45 new vehicles were added, 30 of them were General Motors diesel motor coaches. Fifty more were added in 1947, and another 25 went into service in June of 1948, bringing the total of diesels now in operation to 120.

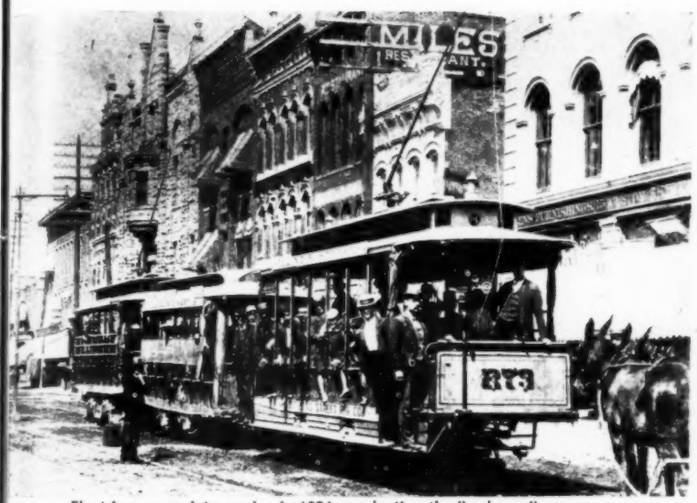
Directing officials of the Indianapolis Railways maintenance department are in complete agreement that "the diesel has a definite place in transportation," and in their more or less brief experience with them they have found that "from a standpoint of fuel cost and dependable service the diesel is a good engine."

These same maintenance men also agree that the torque converter has "made all the difference in the world" in bus operation, because it "gives the motor coach great flexibility even in heaviest traffic." One other reason diesels are liked is that they "give a minimum of engine trouble in times of melting snow or rail-filled streets."

All of the 120 diesel motor coaches now in service are of General Motors manufacture equipped with General Motors 2-cycle, 6-71 engines delivering 165 hp. at 2,000 rpm. All en

Six Weaver lifts make diesel buses easy targets for repair and maintenance at West Washington Street shops.





Electric cars go into service in 1894 supplanting the "mule car".

Air view of the modern maintenance shops of the Indianapolis Railways.

gines are equipped with 60 mm. injectors, which have been found to give abundant power for operation on streets of an almost level city.

These 120 diesel buses run an average of 18,000 miles daily, an average per bus of 150 miles. However, some coaches are in service only during peak haulage periods, some are on long base runs and some on short base runs. Other buses are more or less definitely assigned to certain runs, which of course means a higher daily average. While the normal operation of vehicles is pretty well averaged over a yearly period, some buses will average 300 or more miles per day while others may fall below 150 miles.

Although 120 diesel powered vehicles are in use, a majority of them have not yet reached the overhaul period. Maintenance officials point out that among 25 vehicles bought, as many as 8 or 10 may qualify as "low mileage" vehicles because of human factors which enter into their operation, the type of streets they run on, and other influences apart from the engines themselves. Engines that have been overhauled are these "low mileage" engines. Even so, they have averaged about 115,000 miles before overhaul. Very few have fallen below this mileage and a considerable number have gone well above 115,000 miles before overhaul.

Diesel motor coaches come in for inspection at the end of each 2,000 miles. The inspection charts list the following:

Grease Completely
Injectors
Compression,
Nos. 1, 2, 3, 4, 5, 6
Water Pump—Hose Connections — Radiator — Generator
Doors—operation and air leaks
Air Pressure Lb. reading
Oil Pressure, Max.—— Min——
Manifold bolts and gaskets
Cylinder head bolts
Driving flange bolts
Brakes & Diaphragm
Automatic Shutters
Windshield Wipers
Check Lights
Stanchions
Heater Motors
Front & Rear Springs & Center Bolts
Universal Joints & Flange Bolts
Wheel Alignment
Steering
Oil Filter
Air Filter (Oil bath type
Voltage and Battery Cable
Miscellaneous

Much of the actual testing of a motor is done on a dynamometer which was recently installed. This test determines the horsepower output, the rpm., etc., and serves as a test for the injectors. As an additional aid to inspection and repair, six new Weaver twin-post lifts, each with a capacity of 38,000 lbs., have been installed.

The shops are prepared to handle about 25 vehicles at one time, including street cars, trackless trolleys and buses. In these shops skilled mechanics are prepared to handle every job that may come up, including rebuilding motors, major or minor repairs to bodies and all electrical parts. Many reserve units, including generators and motors complete, are kept in reserve in order to permit immediate return of vehicles to service in case of break down. When this happens the vehicle is brought to the shops, a reserve unit is installed immediately and the vehicle goes back into service while repairs are being made to the unit removed.

New underground storage tanks for fuel and lube oil were installed last spring. These include two 15,000 gallon fuel oil tanks and one 8,000 lube oil tank, all adjacent to five banks of dispensers. Each bank of dispensers handles fuel oil, lube oil and gasoline. The fuel oil and gasoline dispensers each have a flow rate of 30 gallons per minute, to more quickly service the larger buses some of which, especially in winter, may use 70 to 80 gallons of fuel on each run.

Fuel oil is filtered 10 to 11 times before it passes through the injectors. Maintenance officials feel they cannot "filter fuel oil too much," and that they are amply repaid for any extra filtration they may give fuel oil by better performance and lowered maintenance costs. This way, they "keep the engines out of the shops."

Filtration of fuel begins as it is unloaded into the storage tanks. One filter operates where the unloading line is attached, another filter in the same line operates just before the pump. There is another filter at the meter, and in the tank oil passes over five baffles before reaching the dispensing outlet. Two screens and a filter are located at the dispensing pump. On the diesel engine itself fuel passes through two screens and a semi-ceramic filter, the latter an A.C. T-13 with a very fine screen, before it reaches the injector. The injector has its own built-in ceramic filter.

Screen type filters are used on lube oil in five of the six filtering operations. The oil is screened at unloading, and again on the suction side of the pump. Two filters are located at the meter, and on the engine itself are a filter with 1000 to 1200 mesh screens, as well as a sock-type filter which takes out any suspended particles.

As a result of this effort to give their diesels clean oil for both fuel and lubrication, maintenance officials point out, fuel trouble has been cut to pretty close a minimum.

Indianapolis Railways maintenance men are hesitant about expressing a preference for any particular type of filter, offering by way of explanation, "We feel that the products of most of the major filter manufacturers will do excellent work. Whether or not they will give best performance on a specific job depends on their capacity, type, etc., and whether they will function at their best under specific conditions that may exist. "It is our experience," they conclude, "that among filters of comparative quality, one may fit into the needs of our organization better than the others merely because of our particular set-up here."

The fact is, Indianapolis Railways has not yet gone beyond the experimental stage in the filtration of fuel and lube oils. The company's experience with diesel engines has been brief, and no particular filter has been selected for permanent installation. Maintenance officials point out that while they have found most of the filters used "reasonably satisfactory," there are new developments every day and they are constantly on the lookout for something better. When it comes along they want to be in a position to try it.

In the same way, Indianapolis Railways has not committed the company to any one kind of oil. Fuel and lube oils are both purchased on bids, which specify No. 1 oil, and the products of all major companies patronized give adequate service, it is said.

On the basis of four years' experience with diesels, Indianapolis Railways count on an average of 4.5 miles per gallon of fuel oil, taking into consideration all factors such as peak traffic, weather conditions and other things that affect mileage. In summer months this average may go up to 5 miles per gallon.

With approximately $1,000,000 of the current improvement budget yet to be spent, it seems reasonably certain that diesels will be considered along with trolley coaches and gasoline buses.

THE HIGH PRESSURE EXHAUST GAS

By A. H. SISSON*

Fig. 1. First Alco-GE 6000 H.P. diesel-electric locomotive powered with Alco diesels fitted with high pressure turbosuperchargers.

FIRST demonstrated on the latest Alco locomotive diesels nearly two years ago, the G-E high pressure exhaust gas turbocharger can now be fully described.

While this "land" unit is perfectly adaptable to either stationary or mobile equipment, the only installations to date (omitting the experimental units) have been on diesels for locomotive service, so we will devote some space to this application. Reversing the evolution of the high pressure exhaust gas turbosupercharger for locomotives (because that's the way the layman usually becomes informed — finished product and then the contributing details, if his interest holds) we see in Fig. 1 a famous final product, Alco's new "6000," (2000-hp. in each of three cabs) which has made no "helper" runs over Santa Fe's tough old trail of the "Superchief," and in the high mountain passes traversed by the Denver, Rio Grande and Western. Of course, no assisting locomotive is necessary, when an engine can be made to deliver its full load rating at 10,000 feet altitude, as can the units in these three cabs, through the medium of the General Electric turbosupercharger.

Figure 2 shows a diesel engine, with the supercharger mounted in position, the inlet to the turbine element being connected to the engine exhaust, and the compressor discharge to the engine air manifold. No gearing is required to the engine, since at the present stage of development, there is no surplus of turbosupercharger power, over that required to produce the air for combustion of the increased amount of fuel, and to scavenge the cylinders. This piping arrangement is shown schematically in Fig. 3. The simplicity of the elastic fluid "hitch"; its ability to use a portion of the energy, which would otherwise be wasted; and the fact of its completely automatic and instantaneous response to both load and speed changes, and temperature and altitude changes; all make this turbine-supercharger an ideal accessory for improving diesel performance.

In this land set, all the hot exhaust gas from the engine is fed through a properly-proportioned manifold to the turbine wheel, for power extraction to drive the compressor, which in turn supplies high pressure air through another manifold to the inlet valves of the diesel engine. This air is used not only to supply the oxygen to burn the fuel, but it is used also to scavenge the cylinders, during the portion of the stroke when both inlet and exhaust valves are open. Fig. 4 shows a diagram of events on the engine, with approximately 140 degrees of overlapping of inlet and exhaust valves, which has proved to be a satisfactory interval in which to sweep and cool the cylinder space, with air from the constant pressure manifold.

At the present time, the pressure of the "charge" is set at approximately 38 to 40 inches of mercury, which is much higher than the 10 to 12 inches of mercury, which has been used quite generally in the past. However, this lower pressure system, although eminently successful in scavenging, suffers in comparison with the high-pressure unit, when operation is projected to the higher load schedules, on which modern freight and passenger locomotives are required to operate. A study of Fig. 5 shows a marked toeing up of both engine exhaust temperature and fuel rate curves for the older designs, which reflect a lower efficiency of operation, caused by a lack of air required for combustion. The new high pressure system does supply a sufficient quantity of high pressure air to the engine exhaust manifold, which produces the characteristically flatter fuel rate and exhaust temperature curves. At the present level of design, further interesting characteristics of the supercharger as applied to one of the 4-cycle engines in current production are:

Rated speed approximately 15,000 rpm.: maximum speed 18,000 rpm.

Rated horsepower 500 to 600.

High pressure air delivery pressure approximately 38 to 40 inches mercury (19 to 20 psi. gage).

Air quantity at sea level, 15,000 cfm., 75° F. inlet to compressor. (Over 2½ times the quantity provided by the engine when self-aspirated).

Approximate rated load overall efficiency 53 to 56 per cent.

Approximate rated load compressor efficiency 75 to 78 per cent.

Approximate tip speed of impeller (rated load) 1150 ft. per sec.

Maximum inlet temperature to the turbine 1350° F.

Other self-explanatory data are shown in curve form in Fig. 5A.

The supercharger itself shown in Figs. 6 and 7 is essentially a high speed centrifugal air compressor, driven by a high-temperature exhaust gas compact as possible, both the turbine wheel and compressor impeller are mounted on a single shaft which in turn is supported by either journal type or pressure type anti-friction bearings. This closely-stacked construction permits fastening the turbine and compressor casing together, but requires insulation for the hot turbine casing, in turbine. In order to make the unit as light and order to lower the heat transfer to both the compressor and the cab of the locomotive. A limited amount of air is bled from the compressor discharge to pressurize the metallic-labyrinth type seals, thus preventing lubricating oil from entering the air and hot gas paths.

Performance of these units has been probed very exhaustively, both in elaborate test cells at the factory in which they are manufactured, and on the engine in the engine-builders laboratory, before going into locomotives for road service. The test cell, Figs. 8 and 9, is equipped with the necessary manometers, thermometers, tachometer and other instruments, to determine the "hot gas" performance of a unit before shipment to the diesel builders.

This "bootstrap" run (so-called because of its similarity to picking oneself up by the bootstraps) yields a definite amount of data, which allows prechecking performance of actual operation on the diesel engine, and also serves as an operational hot high speed run. While this test is not quite the same as running on the engine, it is possible to determine an approximate value of overall efficiency for the set, (using the recorded inlet and discharge pressures and temperatures of both the turbine and compressor) simply by dividing the calculated adiabatic energy rise in the compressor by the calculated adiabatic energy drop in the turbine. In the manipulation, we assume that the same flow goes through the turbine that goes through the compressor, and for which we assume that the weight of fuel added to support operation

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TURBOSUPERCHARGER

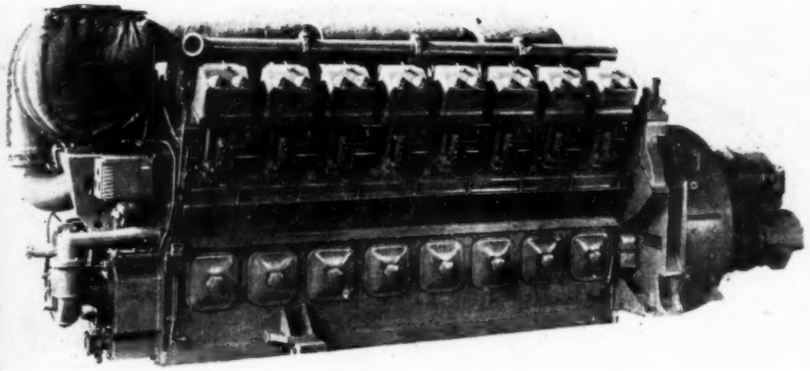


Fig. 2. Alco 16-cylinder locomotive diesel with G-E turbosupercharger, upper left.

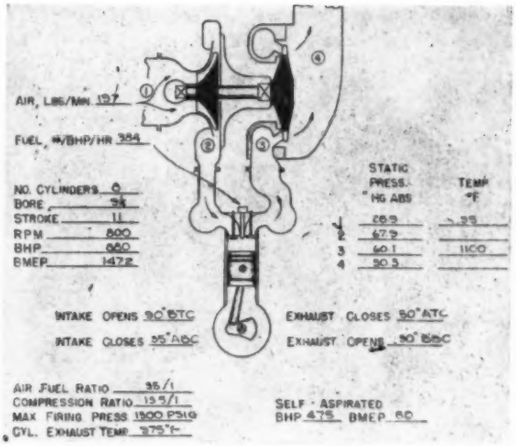


Fig. 3. Schematic arrangement of turbosupercharger with comparison of supercharged and self-aspirated data.

cancels approximately the weight of air used to purge the seals. It is also possible to check the compressor efficiency fairly closely (neglecting radiation) by comparing the calculated adiabatic temperature rise with the actual temperature rise obtained from the test data. Summarizing then, this single test enables us to check approximately:

(1) Overall efficiency of turbine supercharger

$$\frac{\text{adiabatic energy of compressor}}{\text{adiabatic energy of turbine}}$$

(2) Efficiency of compressor:

$$\frac{\text{adiabatic temperature rise in compressor}}{\text{actual temperature rise in compressor}}$$

(3) With the approximate overall and compressor efficiencies known, an approximate turbine efficiency is obtained by dividing the overall efficiency by the compressor efficiency.

Thus the test becomes an important factor in production, and is worthy of at least passing notice. Fig. 9 shows the basic components of the cell itself, with the turbosupercharger in the circuit. Air enters the cell through an air filter and silencer in the roof, passes through a metering venturi, to the impeller inlet. After going through the impeller and diffuser, the air travels through a manifold to the oil burner, where combustion occurs; and thence the now-heated-gas goes through another manifold to the turbine scroll type nozzle box; through the wheel and out the exhaust stack to the atmosphere. The fuel required to support this process, of course, prevents the set-up from being of the "rats-eat-the-cats-and-the-cats-eat-the-rats" variety and, therefore, it is not completely "bootstrap" even though so-called. This system is not self-starting, and requires an auxiliary air or steam boost, which is used until the unit reaches a self-supporting speed.

Having now backed up through the schedule of this product to the point of manufacture, we will pass over this phase very briefly, since it has been covered quite completely in another article. It will suffice to say that a turbine wheel, flash welded to a shaft; buckets, welded to the wheel; compressor diffuser and turbine scrolled inlet and exhaust casings, fabricated from steel plate; and brand new high-temperature alloys, all have presented problems of fixturing, machining, and heat-treating, which have taxed the ingenuity of both the engineering and manufacturing groups involved, to produce a unit which will meet the exacting demands of these high speed, high temperature, high pressure turbosuperchargers.

The very unglamorous, albeit necessary, engineering calculations and drafting detail can be sidestepped completely in order to discuss data which will help diesel owners and diesel manufacturers to check for themselves, and see if a high pressure turbosupercharger system could be applied to their engines to step up power. Although it is possible to effect an increase of 80 to 100 per cent above the ratings of engines of the same displacement designed for natural-aspiration, with an entirely new design, it is often possible to obtain 30 to 50 per cent increase in power on an existing engine, provided the resulting torque, cylinder pressure, and temperature will be within recognized safe limits. We show a summary of typical proposition information required, to determine if a turbosupercharger should be considered, when power must be increased by some means or other. This information conveniently grouped around diagram (Fig. 3), indicates the sort of detail required. Let's suppose that we have engine information as tabulated on the diagram, and that we want to know if it's possible to obtain 85 per cent increase over the normally aspirated rating, by means of an exhaust gas turbine-supercharger.

If the engine will withstand pressures and temperatures as indicated, and if the increased torsional stress still shows satisfactory margins of safety, the answer is yes. Now let's see how we get it, not with all the painful detail of the total calculation—the highlights only will suffice.

Example: (With derivations of values for Fig. 5, which are required for the design of the turbine-supercharger.)

9¼" x 11" engine, 8 Cylinders, 800 rpm.

13.5:1 Compression ratio.

Unsupercharged rating is 475 hp. (80 bmep.)

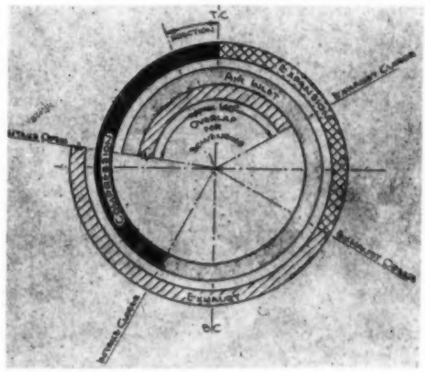
Supercharged rating is 880 hp. (147.2 bmep.)

For the illustration we will set up certain reasonable assumptions which are borne out in actual operation. We will assume that:

Air/fuel ratio = 35:1

Engine thermal efficiency = 34%

Fig. . Engine events diagram.



H.H.V. of fuel = 19500 Btu/#

Barometer = 29.6"

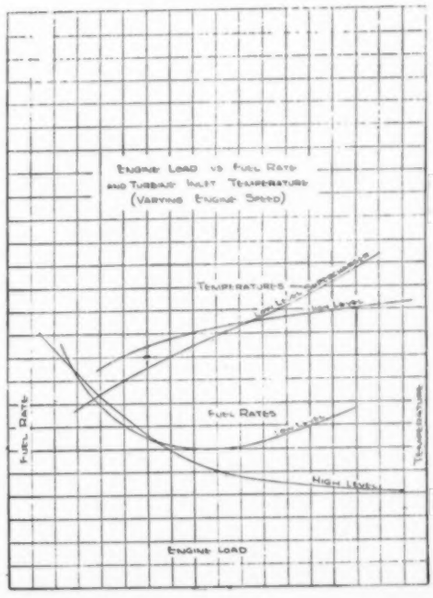
Compressor inlet filter drop = 10" H_2O = 0.7 Hg.

Compressor inlet pressure = 29.6 − 0.7 = 28.9" Hg. Abs.

Compressor inlet air temperature = 95° F.

Cylinder exhaust temperature = 975° F.

Fig. 5. Engine load vs fuel rate curves.



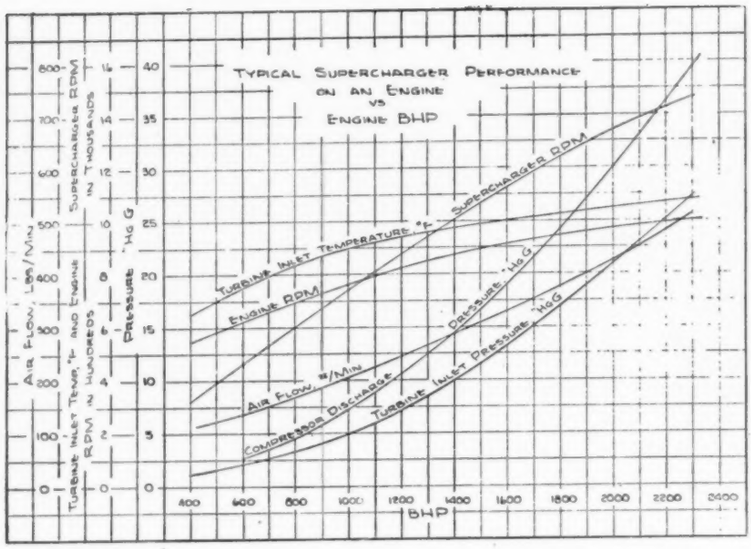

TYPICAL SUPERCHARGER PERFORMANCE ON AN ENGINE VS ENGINE BHP
AIR FLOW, LBS/MIN
TURBINE INLET TEMP. °F AND ENGINE RPM IN HUNDREDS
SUPERCHARGER RPM IN THOUSANDS
PRESSURE "HG G
SUPERCHARGER RPM
TURBINE INLET TEMPERATURE °F
ENGINE RPM
AIR FLOW, #/MIN
COMPRESSOR DISCHARGE PRESSURE, "HG G
TURBINE INLET PRESSURE, "HG G
BHP

Fig. 5a. Typical supercharger performance curves.

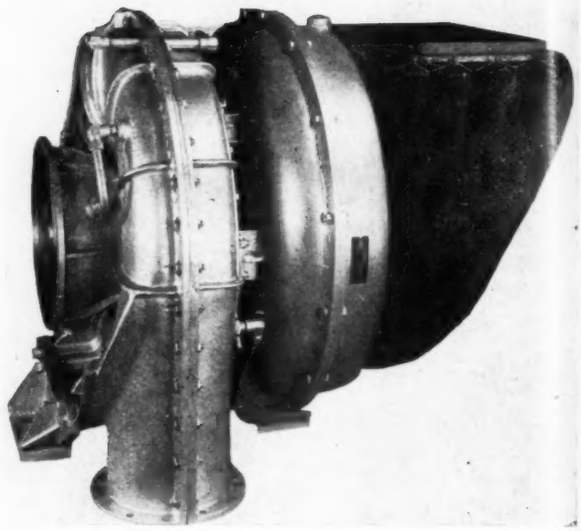


Fig. 6. The G-E turbosupercharger assembly.

Compressor flow equals turbine flow

Compressor discharge pressure = 68.3″ Hg. Abs. (between 38″ 7 40″ G.)

Compressor efficiency = 75% (see tabulation Fig. 10)

Turbine efficiency = 70%

Turbine discharge pressure = 30.3″ Hg. A.

From Fig. 11 we see that 5.63 pounds of fuel per minute are required to give 880 bhp. at 34 per cent engine thermal efficiency. Since our air/fuel ratio is 35/1, a flow of 197 pounds of air per minute is required, which value is required for the design of supercharger, and is entered on Fig. 3.

With the inlet filter drop, we have a compressor inlet pressure of 28.9″ Hg. Abs. The compressor discharge pressure is 68.3″ Hg. Abs. which gives a compressor pressure ratio of 2.36.

Experience indicates that a temperature rise takes place in the lagged exhaust manifold on the order of 100-150° F. We will use 125° F. which gives a turbine inlet temperature of 1100° F.

We are now ready to use the compound net work curve (Fig. 10). At the compressor pressure ratio of 2.36, we enter vertically and proceed to the compressor inlet temperature line (95° F.), then horizontally to the left to the turbine inlet temperature line (1100° F.), and vertically to the intersection with the 75 per cent compressor efficiency line, horizontally to the right to the intersection with the 70 per cent turbine efficiency line, and finally, vertically to the turbine pressure ratio scale where we obtain a value of 2.067 (which, with inlet temperature and gas flow, establishes the design conditions for the turbine.)

Both the compressor and turbine pressure ratios are based on impact pressures. Because of large passages and relatively low velocities, the impact heads at compressor inlet and turbine discharge are negligible. At the compressor discharge, the impact head in this example is .4″ Hg., and at the turbine inlet, the impact head is 2.5″ Hg. For simplicity's sake, the calculations to derive impact heads have been purposely omitted, but values of these magnitudes may be taken for most cases at or near rated load (since the size of the supercharger passages would vary approximately proportionately with the engine rating), without introducing any serious error in the calculation. Subtracting the impact head in the two cases gives static pressures of 67.9″ Hg. Abs. in the engine inlet manifold, and 60.1″ Hg. Abs. in the exhaust manifold—a differential of 7.8″ Hg. and which is ample for scavenging. (The pressure differential requirement varies, of course, with different engines. However, if the value is not less than six inches of mercury, we would expect that scavenging would still be accomplished.)

If the engine we have chosen for the example did exist, we would expect to be able to make it deliver at least 85 per cent in excess of its self-aspirated rating, by attaching a properly designed high-pressure supercharger, and if this particular size supercharger has already been developed, the cost to obtain this added power would be only a small fraction of the cost of the 85 per cent bigger self-aspirated engine.

Should the differential pressure across the engine as worked out by the above method, be less than six inches of mercury, in any example the reader may choose, the use of the high pressure supercharging system is by no means ruled out. From the standpoint of the turbosupercharger alone, we might say—"burn more fuel in the engine and allow more energy to be delivered to the turbine." However, this means can be used only up to the limits of temperature and stresses on the engine. Beyond this point, probably the most effective expedient would be to alter the valve timing of the engine, until the engine-supercharger system will have attained its optimum performance. Probably the altering of the valve timing would be a sufficient change to produce scavenging, should any adjustment be found necessary. Other means of improvement do exist, which are beyond the scope of this article.

When we begin to wonder what the future holds for the high pressure supercharger for diesel engines, we can visualize it first passing through a cycle of still higher pressure, when engines are made to withstand the higher loading per cylinder. Along with this higher pressure (and possibly before) will come after-cooling of the compressor discharge, to effect better scavenging, and better volumetric efficiency, thereby making appreciable gains in power. It is entirely probable that in this development, both the turbine and compressor will be built with more than one stage for higher efficiency.

There would come a time in this program (with the turbine developing more and more power, as the charging pressure is raised) when the "tail" literally, would "wag the dog." Then the power delivery of the diesel engine would be only equal to the power required by the compressor. When such an extreme condition occurs, the turbine will be able to produce all the net work, and may be cut loose from the compressor, with the diesel taking over this duty. Operation then may be likened to that of a conventional steam turbine, only in this case the diesel engine will become the "boiler" to provide the elastic fluid, (at pressure and temperature) which will run the turbine to carry the load.

It is difficult to predict if this gas-turbine combination will compete with the combustion-gas turbine, which has received so much attention recently, and which seems to offer a very hopeful outlook for certain types of power generation in the future. However, there seems to be no reason why this gas-generating diesel and gas-turbine combination might not parallel the combustion-gas turbine development if it can be made competitive in price.

All the foregoing discussion has dealt with turbosupercharger for four-cycle diesels, but it would not be proper to conclude this article without at least mentioning the possibility of its application to a two-cycle engine. The two-cycle engine differs from the four-cycle type in that it is not self-breathing, and therefore, not self-supporting at start-up and at light loads. Therefore, an exhaust gas turbine alone will not fill the bill, as it does in the four-cycle engine where it is literally carried along by the self-aspirating property of the engine until there is enough energy in the exhaust gas to make the turbosupercharger begin to deliver air pressure.

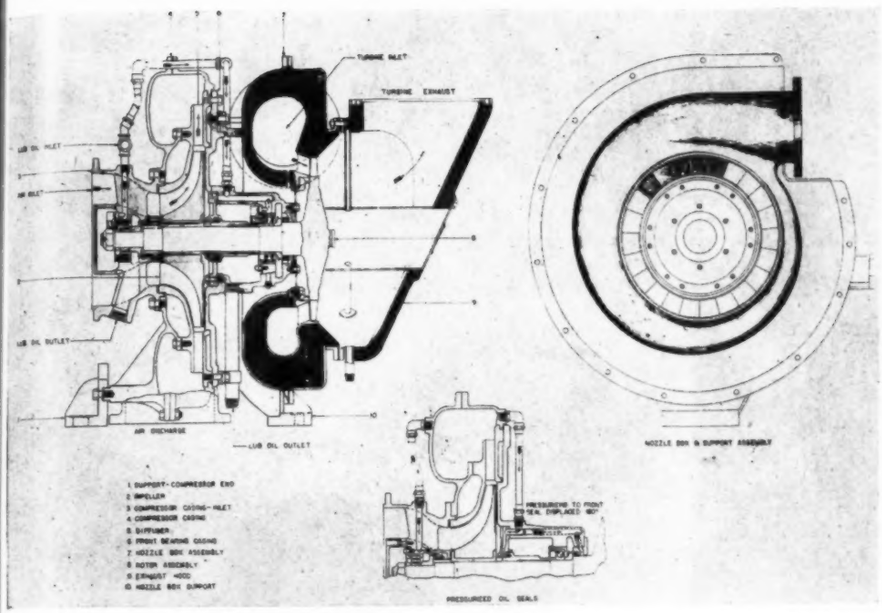


Fig. 7. Sectional views of the supercharger.

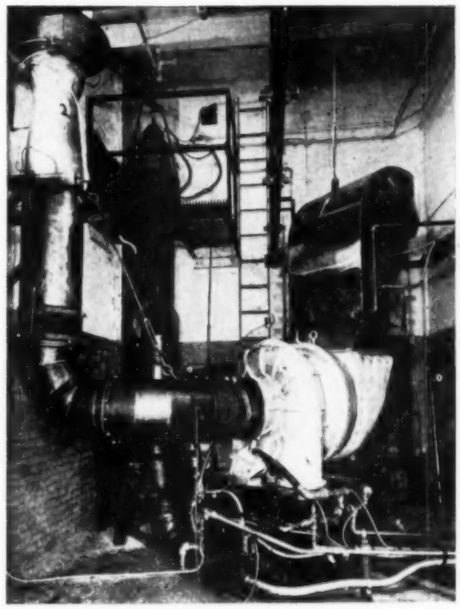


Fig. 9. Schematic arrangement of test set-up.

The two stroke engine will use the exhaust gas turbine only if scavenging air is supplied, by either an air compressor driven from the engine crankshaft, or by an independent motor, to insure starting and light load operation. This auxiliary air system might be arranged to cut out, when the turbine will supply sufficient air, and to cut in again, when it will not in order not to penalize overall performance at the higher loads and at altitude. So there is a way to use this supercharger on the two-cycle engine, although not as simply as on the four-stroke engine.

There have been statements made, in a less enlightened era, which implied there was little hope for the high, constant-pressure turbine-supervharger, and which over-stressed the importance of a scavenging ability, but breezed right over the real "load-getter," the high pressure charge, which really produces bmep. in a diesel.

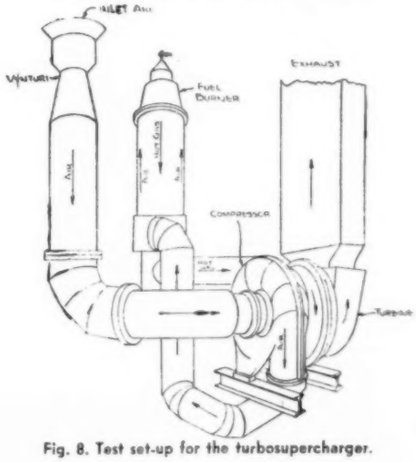
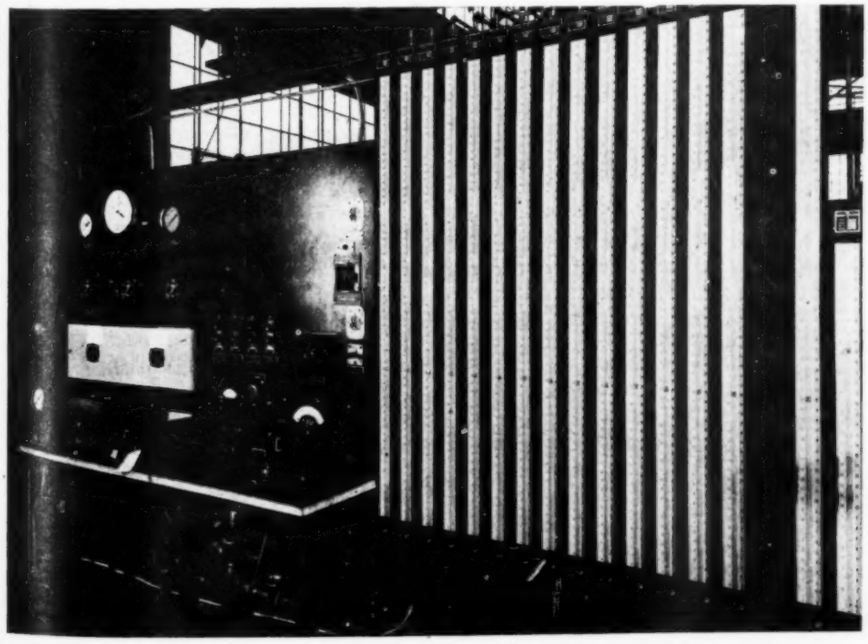


Fig. 8. Test set-up for the turbosupercharger.

Fig. 8a. Instrumentation for the test cell.



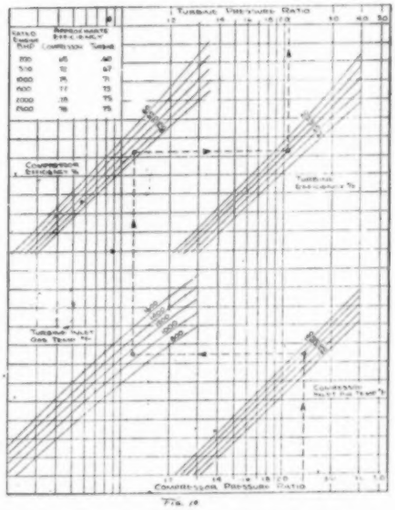
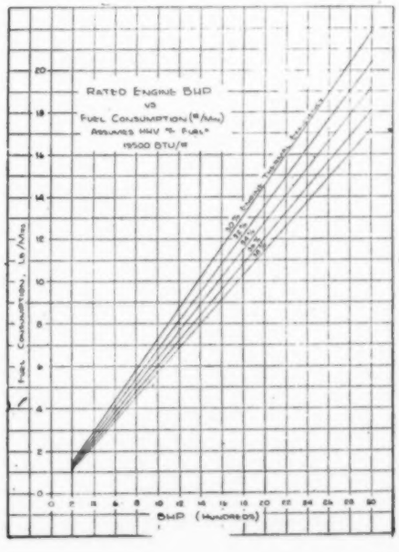
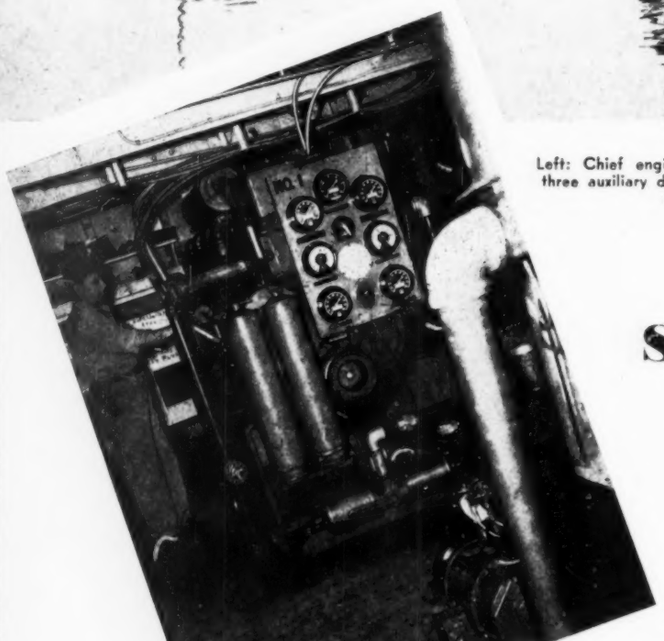


Fig. 10. Turbine-Compressor efficiency chart.

Fig. 11. Engine output vs fuel consumption chart.



Above: Owned by Erie Sand Steamship Co., this commercial dredge was recently converted with two GM Cleveland Diesel main engines.



Left: Chief engineer, John Jarecky, attending one of three auxiliary diesels—Superior 8-cylinder, 150 hp. units with 100 kw. generators.

SANDSUCKER CONVERSION

JOSEPH S. SCOBELL modernized with diesel-electric drive

By WALTER RUDOLPH

One of two Hilco units for lube oil maintenance on the main diesels.

IN THE interest of greater speed and more efficiency in all phases of its operations, it was decided to convert the sandsucker, *Joseph S. Scobell*, owned by Erie Sand Steamship Co., to diesel-electric power. Conversion was completed last May and the ship now makes regular runs from the Erie Sand & Gravel Co. docks, Erie, Pa.

For the record, this ship has seen many uses since its construction in 1891 by the American Shipbuilding Co., Cleveland, Ohio. A vessel of 1445 gross tons, it was originally intended for bulk cargo shipping; a conventional light type boat, it is 266 feet long and 38 feet, two inches in width.

For a number of years previous to its present ownership, it operated in the lumber trade. Erie Sand Steamship Co. purchased it in August, 1937, from Jones Lumber Co., Tonawanda, N. Y. A conversion was immediately necessary to fit her for sandsucking.

In addition to installation of dredging pumps, various steam-driven engines for powering dredging pumps, etc., the Erie firm fabricated two cargo holds, one 60 feet by 24 feet, two inches, by 20 feet, one-half inch, and a second 67 feet by 24 feet, two inches, by 20 feet, one-half inch. These gave the *Scobell* a total capacity of some 2,000 cubic yards of sand, or about 3,000 tons.

At that time she carried two boilers, each of 145 pounds pressure, to power a reciprocating triple expansion engine turning up 900 horsepower. Two 200-horsepower fore and aft compound steam engines were used to drive the 16-inch Amsco dredging pumps. A deck conveyor belt was powered by a gasoline engine, while the

boom that traveled sand to the dock storage piles was electrically-driven from the ship generating unit. The unloading crane, sitting amidships, was gasoline-driven, and remains so today.

The conversion necessitated gutting of the entire power plant or engine room and the removal of steam-powered engines throughout the boat (in dredge pump room, for instance.) All structural work and placing of equipment for the diesel-electric installations was handled by the Paasch Marine Service, Erie, Pa. Robert Scatterday, of Cleveland, O., was consulting electrical engineer.

Heart of the new engine room is a pair of General Motors two-cycle, 12-278, 12-cylinder V-type diesel engines. Each develops 1035 horsepower, and is coupled directly to a General Electric 710 kw. generator. Each generator, in turn, supplies an 885 hp. General Electric motor.

The two motors drive a Farrel-Birmingham, twin-pinion, single reduction gear delivering 1500 shaft horsepower. When the ship is underway, either of the two diesels can be used to keep her running as each gives more power than the original steam-powered engine. The *Scobell* formerly made a maximum 11 miles per hour, loaded, while today it can make 14 mph.

"Primarily, the picture is this now," commented Harry M. Bouchard, marine manager: "We can be underway and dredging, using one diesel to run the ship, while the other main engine supplies power with which to operate the dredging pumps.

"Each of the dredging pumps is now powered through a 28-strand V-belt, coupled between its 56-inch driving pulley, and the motor's 16-inch pulley. Each of the motors is a 250-horsepower General Electric unit. The winches that lower and raise the sucking pipes are also powered by General Electric motors. There is a separate dredge pump power and operating control panel in the pump room."

Forward of the main engine room is the auxiliary power room. Here are installed three (two regular and one standby), Superior 8-cylinder diesels, 150 horsepower each, coupled to individual 100 kw. generators. Here also has been installed a small oil-fired boiler for heating purposes. The conversion also included installation of all electrically-driven pumps, used, for instance, for fire, bilge, ballast, cargo, sanitary, fresh water, lube oil, and cooling pumping.

Auxiliary generating pumps have a separate switchboard and control panel near the auxiliary installations. On a center elevation aft of the main engine room are installed two Ingersoll-Rand air compressors for starting the main engines, the fresh water pump, service pumps (for lavatories, etc.), and other equipment, including control boxes.

On the top elevation aft, of the main engine room is located the main propulsion control panel. To its right is the dredge pump power panel, thus centralizing for chief engineer, John Jarecky, the main "nerves" of the entire diesel-electric conversion.

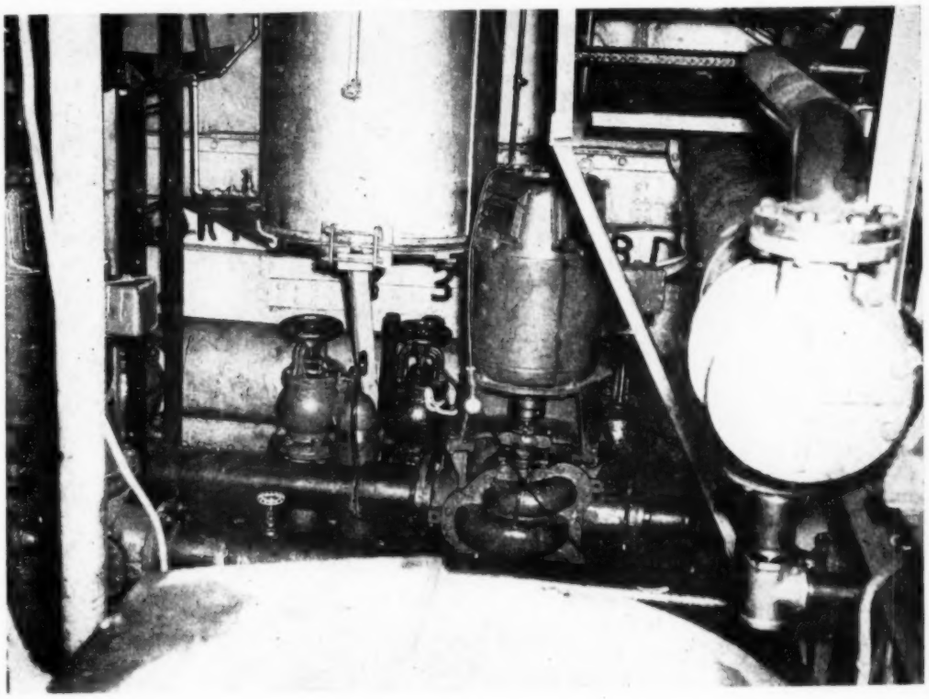
One of the best features among conversion details is the installation of automatic controls in the pilot house, enabling the master to operate the ship without any assistance from the engine room. This is Askania Company equipment, known as an Electronic Speed Control.

Other details of interest include installation of a DeLaval centrifugal oil purifier through which fuel passes to the "Day" fuel tank in the main engine room. Gardner-Denver ballast pumps, vertically installed, are also in the main engine room, along with the lube oil cooler and miscellaneous other pumps. Alongside each of the main engines are individual Hilco filters.

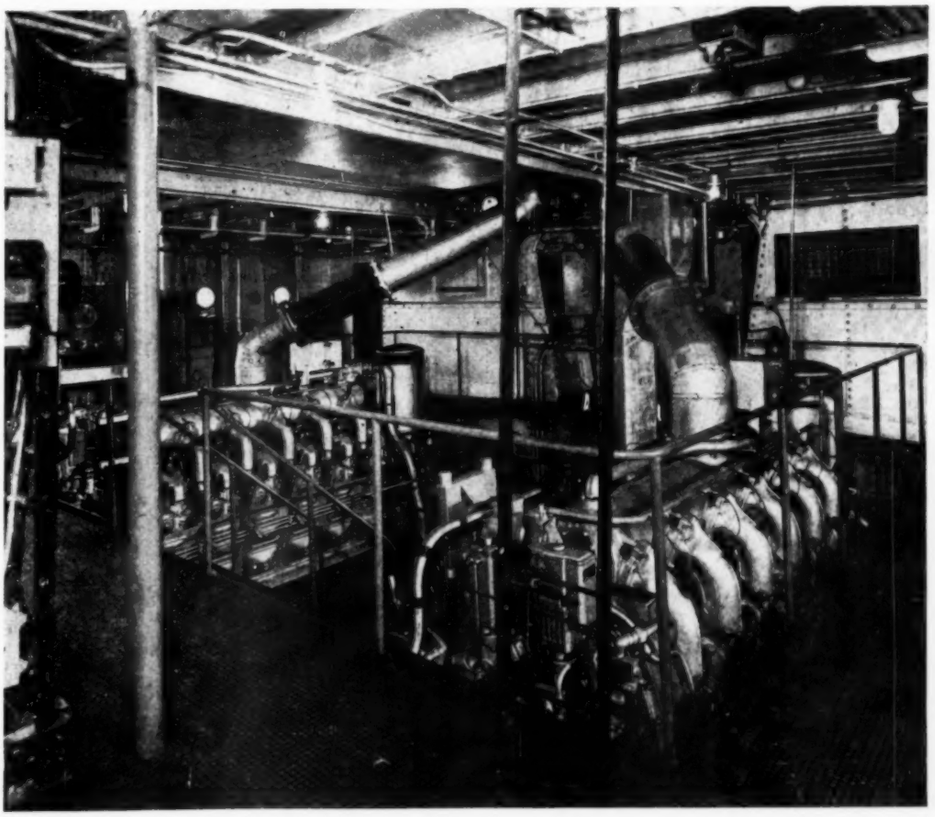
"There's really nothing like the *Joseph S. Scobell* anywhere in marine service," said Bouchard. "She has been converted for specific, obvious reasons, and we feel that she will now give more efficient, dependable service."

Her skipper is Capt. Fred Mastine.

Gardner-Denver vertical ballast pump, center, and lube cooler, right, seen from center elevation of main engine room.



Pair of 12-cylinder Cleveland diesel main engines on the "Scobell"—1750 total shaft hp.



An International UD-24 Diesel power-unit recently purchased by the Miller-Bond Lumber Company of Pine Hill, Alabama. Power is provided to operate 56-inch saw, edger, trimmer, slab chain, lumber chain, and sawdust chain. Logs are chiefly pine and cypress and are hauled an average of 8 miles by two International trucks.

This intermediate-sized new model International UD-16 Diesel power unit had been in operation only 7 days when pictures were taken and was doing a big job for its size for the Arnold Lumber Company of Hogansville, Georgia. It is operating 48-inch saw, edger, slab conveyor, sawdust chain, and log conveyor.

Portable Sawmill and Planing Mill Diesels

INTERNATIONAL Harvester recently added to its power-unit line two new four-cycle, valve-in-head diesels, the UD-24 and the UD-16, and has applied many of these as portable engines for sawmill operation.

The UD-24 engine is basically the same as that in the new TD-24 Diesel tractor, the largest in the International crawler line. The UD-16 is a smaller power unit for use in the intermediate diesel power-unit field, and in size is between the UD-18A and UD-14A.

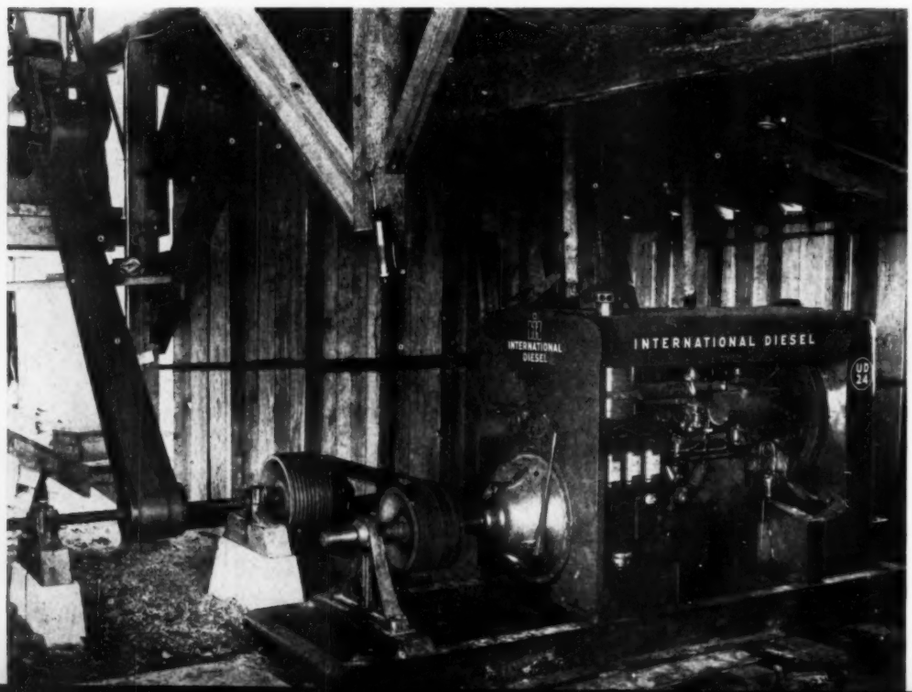
The UD-24 is a six-cylinder, 1090-cubic-inch displacement, full (compression-ignition) diesel engine with a 5¾ by 7-inch bore and stroke. Equipped with radiator, fan, clutch, and power take-off the UD-24 power unit develops 180 hp. at 1375 rpm. The engine without radiator, fan, and clutch develops 191 hp. at 1375 rated rpm.

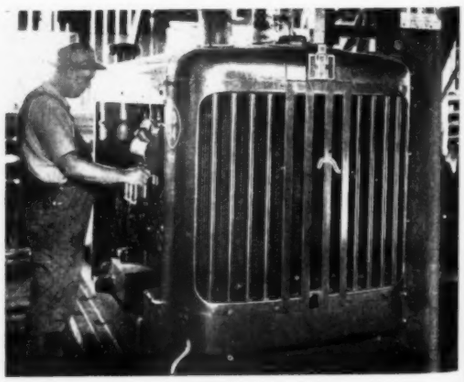
The International UD-16 is a six-cylinder, 100-hp. power unit with 501-cubic-inch piston displacement and 4.4 by 5.5-inch bore and stroke. It is the first diesel engine developed by International Harvester with intake manifolds on opposite sides of the engine. Test results have been so good that they led to the development of the UD-14A and UD-18A increased-power engines as well as to the giant UD-24 of similar design.

Since the sawmills operated by these new power units are frequently moved from place to place, often in out-of-way localities near sources of supply, the lack of permanence is always apparent in the setups as shown in accompanying illustrations. Frequently operations are conducted entirely out in the open. This is often the case in the South. If the equipment is housed, it usually is of the open-shed type.

Because of its greater power output, the UD-24 is especially well adapted for planing mills. In this class of work, the mills are more permanent and so are better housed.

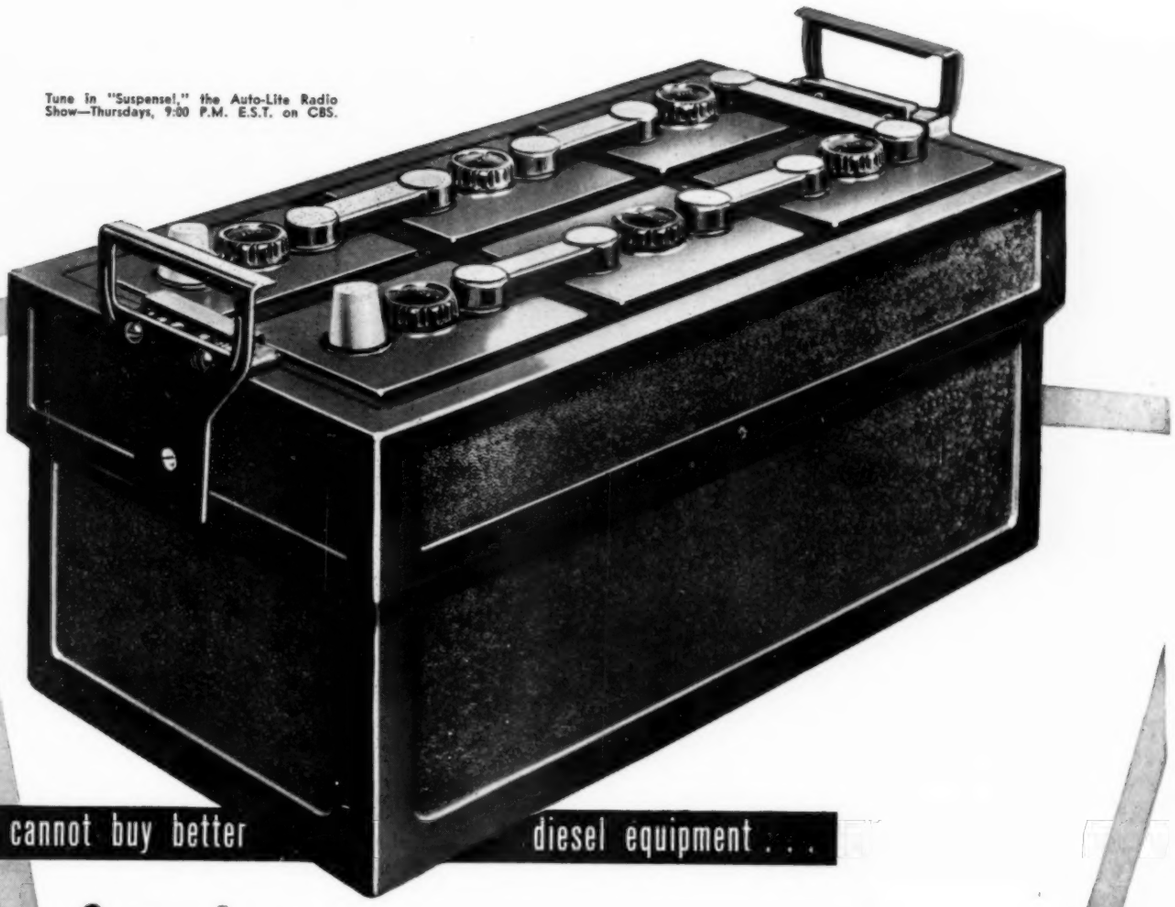
Here is shown Foreman C. H. Larkin of the Meriwether Lumber Company of Woodbury, Georgia, shutting down at noontime the new model International UD-24 Diesel power unit which it recently purchased to operate its planing mill. The UD-24 operates the entire planing mill, trim saw, blower fan, etc. The mill output is 40,000 feet a day of lumber which is mostly yellow pine and some hardwood.





A businesslike planing mill installation is that of the Mutual Lumber Company at Edgewood Street and Kings Road on the outskirts of Jacksonville, Florida. The mill is operated by the new Model International UD-24 180-hp. Diesel power-unit shown here.

Tune in "Suspense!," the Auto-Lite Radio Show—Thursdays, 9:00 P.M. E.S.T. on CBS.



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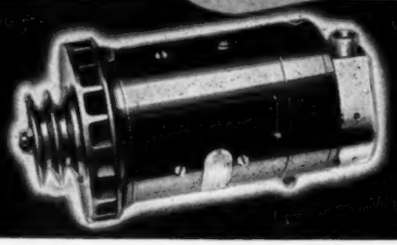
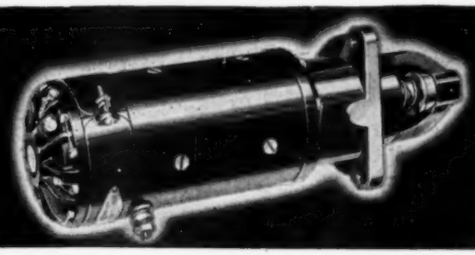
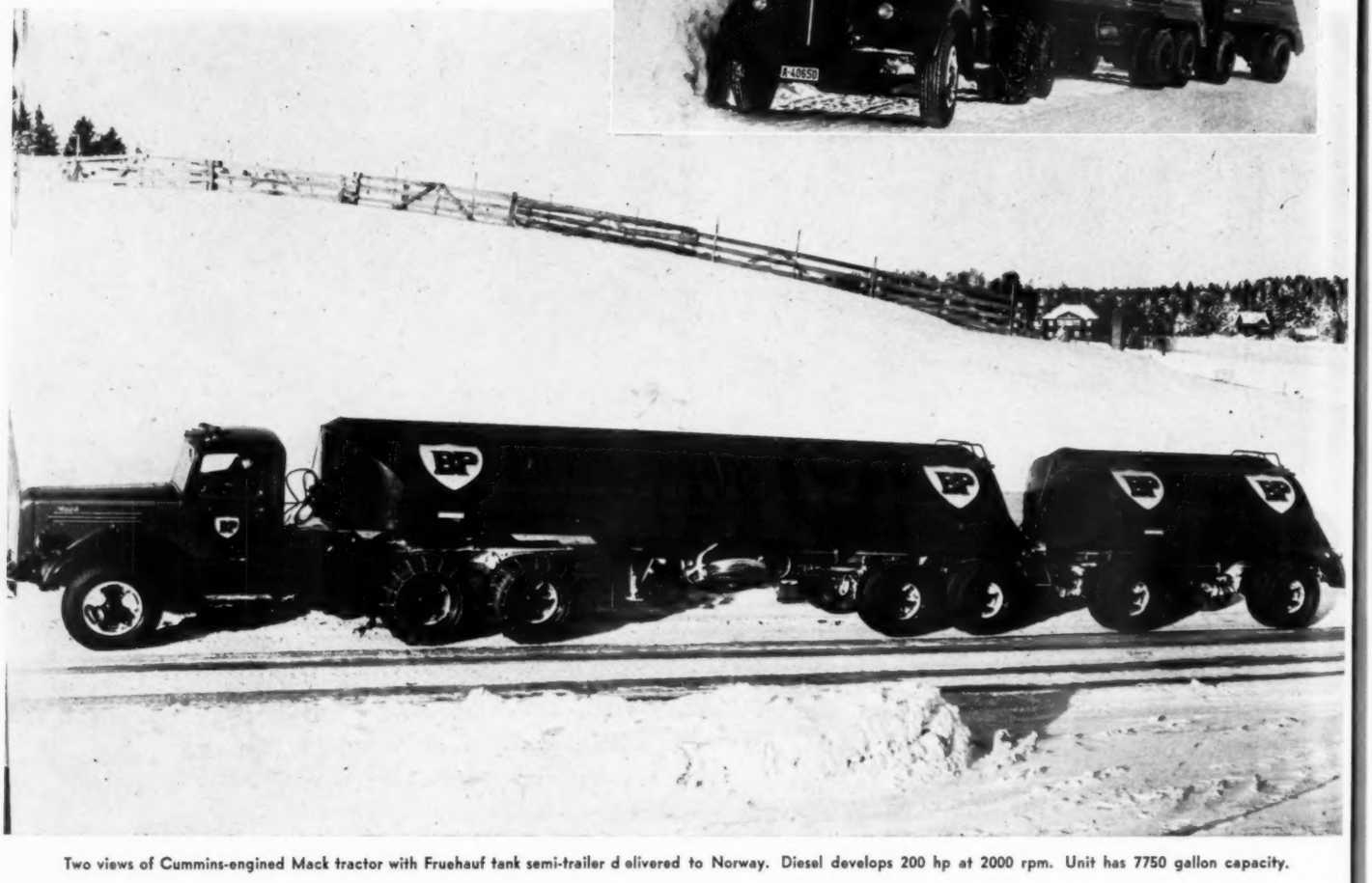




BATTERIES
GENERATORS
STARTERS

American Truck Unit In Norway



Two views of Cummins-engined Mack tractor with Fruehauf tank semi-trailer d elivered to Norway. Diesel develops 200 hp at 2000 rpm. Unit has 7750 gallon capacity.

WIDESPREAD interest was aroused in Oslo, Norway, last winter when an American-built tractor trailer was demonstrated to executives of the Norwegian Ministry of Transport, Highway Directorate Ministry of Supplies and members of the press by the subsidiary Norwegian company of the Anglo-Iranian Oil Company, Ltd.

The unusual interest evidenced by the introduction of this tank train had two reasons. The first already well known in this country by actual experience was relief to oil-starved factories and homes promised by this large capacity (7750 gallons) Diesel engined truck tank-train and second was the unit's unusual size which had caused a great deal of curiosity as to its ability to maneuver in the narrow streets and highways of the country, which are not noted for easy driving.

The unit consists of a Mack tractor, a 5250 gallon Fruehauf semi-trailer, and a 2500 gallon Fruehauf four-wheel trailer. The tractor is equipped with a Cummins Diesel engine developing 200 hp. at 2000 rpm. Transmission is of the Mack type with ten speeds forward and two in reverse. All wheels are equipped with Bendix Westinghouse air brakes. A Roper pump rated at 100 gpm. is installed to handle oil pumping.

Behind the delivery of this unit is the story of whole-hearted cooperation between leading American manufacturers. In the summer of 1947 R. L. Vaniman, Vice-President of the Fruehauf Trailer Co., who was visiting Norway, had his attention drawn to the country's acute need for the vehicle during the coming winter months and to the long delivery time on the vehicle due to its special Diesel installation and other specifications. Close teamwork on the part of Mr. Vaniman, H. E. Seanor, vice-president of the Mack-International Motor Truck Corporation, and C. L. Cummins, President of the Cummins Engine Company resulted in a delivery promise of 90 days after order. The schedule was maintained and the vehicle was loaded onto two Norway bound liners early in November of last year.

In addition to the government and newspaper guests at the demonstration of the new equipment, a great many interested truck owners and drivers were present. Many of the equipment items installed were examined with great interest as they had never before been seen in Norway. The event was given wide newspaper and radio publicity and was even covered by the news reels.

"Sohio Fleetwing" tow using two diesel 300 H. P. Model O-72 units with electric remote controls to pilot house.

Illustrating 180° elevation

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Figure out the loss of time in your own operations due to double-tripping — then hark back to the example above. Whether you operate big tows or small, "Harbormaster" thrust power can save you time and money. Call or write today for full details and applications of all ten "Harbormaster" models ranging from 20 to 300 H.P. — ask about the many other exclusive operating and maintenance features which save time and money — let the "Harbormaster" push your profit up!

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SELECTION AND OPERATION OF OIL RECLAIMING EQUIPMENT

By WILL H. FULLERTON

Editor's Note: The following discussion is based on material supplied by the Hilliard Corporation. This is the first of a series of informative articles on the operation and maintenance of diesel auxiliary equipment and should prove valuable for reference purposes.

THE first and most important factor to be considered in choosing oil conditioning equipment is this—What are the requirements of the particular operation? Under this heading many questions pop into the operator's mind. Should he consider batch, full flow, or by-pass filtration? Should he demand a combination system? Should he consider the installation of an oil reclaiming unit? How big a unit is required?

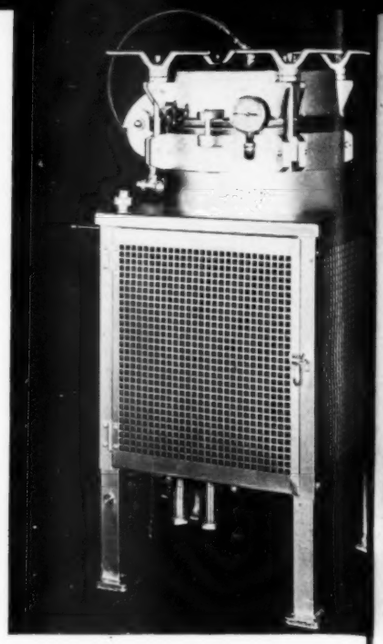
To answer these and other questions, the operator must know the characteristics of his engines. He must know the rate of oil flow to and from the engine, the temperature of lube oil, and the capacity of the engine lubricating system. He must know the operating characteristics of the engine under various loads and conditions. He must consider the type fuel and lube oil he is using in the engine. He must find out whether he is getting clean air into the engine cylinders.

The various filter manufacturers can be of great help to individual operators by supplying information and recommending installations to improve diesel operation.

The Hilliard Corporation is now engaged in just this type of aid to diesel operators. Hilliard engineers recommend that equipment be installed for continuous operation to remove contamination as fast as it is formed. They further break down the products of combustion into two classes of contaminants: 1: Carbon, soot abrasives, tarry matter and acids, 2: Fuel dilution, water, dissolved gases and other volatile contaminants.

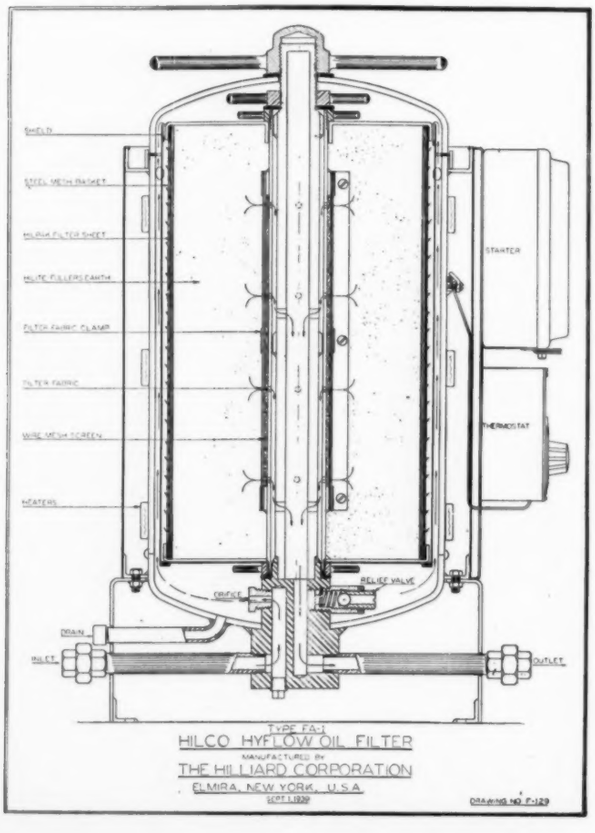
Removal of contamination products found under group one can be accomplished through the use of "Hilco Hyflow" filters which are cartridge type and can be supplied with fullers earth or cellulose cartridges depending on filtration requirements. For removal of contamination listed under groups one and two, oil reclaimers are recommended. These units distill water and other volatile contaminants from the oil as well as remove mechanical and acid contaminants.

The "Hilco Hyflow" filters are manufactured in four series for various types of application. The standard series has a capacity of ½ to 4 gpm. depending on the number of filter cartridges contained in the unit. These range from 1 to 8. The

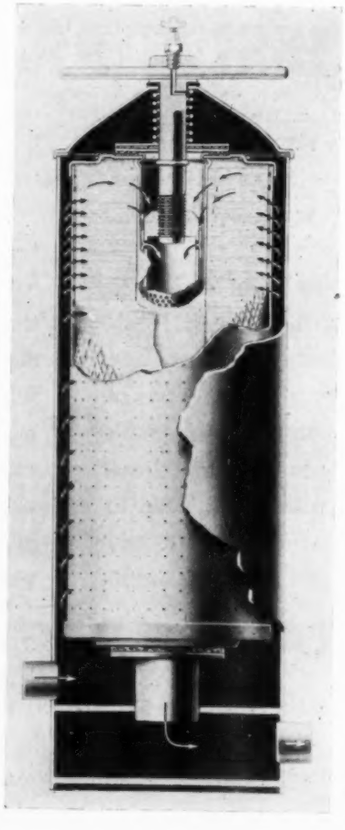


Hilco Model B-1 Reclaimer which re-refines lube oil at a cost of 1.4c a gallon.

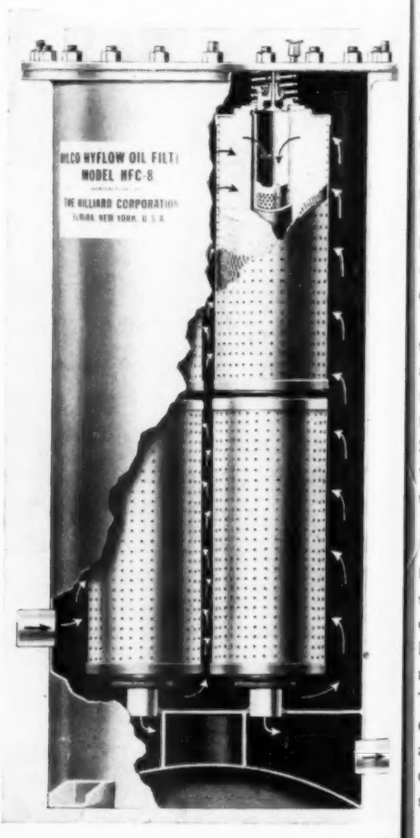
Cutaway drawing of Hilco filter showing construction details.

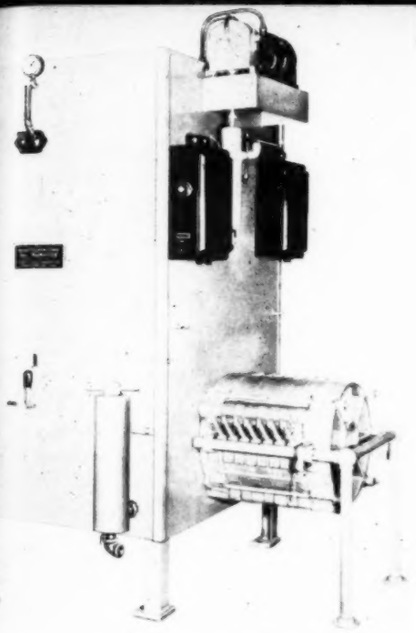


Model RP-1 Hilco filter cutaway to show construction and direction of oil flow. This particular model has a 30gph capacity.

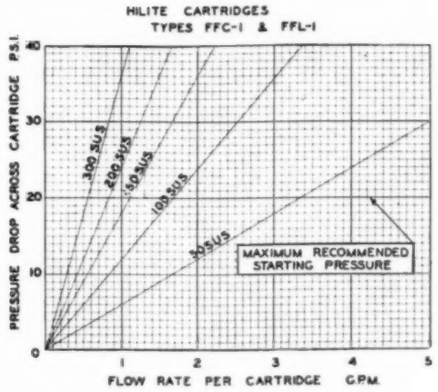


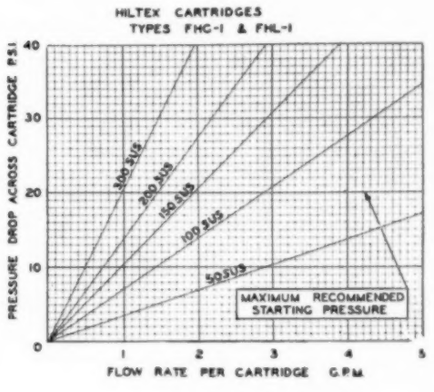
Hilco "C" Series filter designed for diesel lube oil filtration for engines up to 2000 hp. It is rated at 120 gpm capacity.



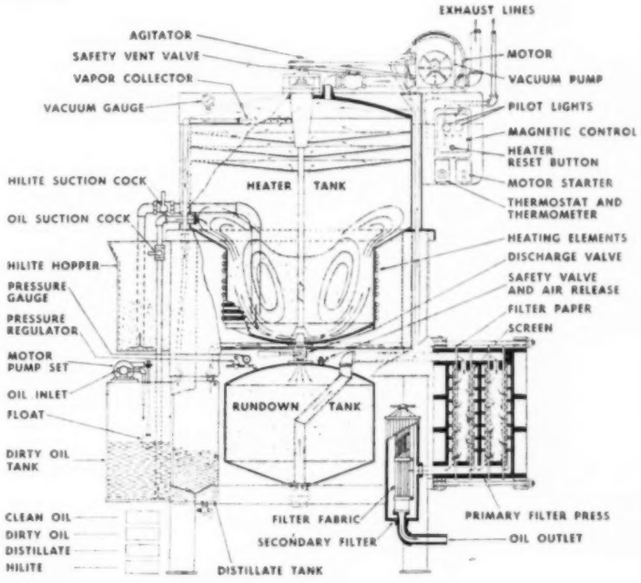


Largest Airline Purifier reclaims approximately one gallon of lube oil per minute. Operation is automatic.





Flow — Pressure — Viscosity curves for Hilco standard filter cartridges. Fullers earth type, left; Cellulose type, right.



Schematic drawing of Hilco Airline filter showing process of reclaiming.

cartridges may be either cellulose or fullers earth-packed. The cellulose cartridges are recommended for use with compounded oils since they will not remove additives. These filters are recommended for direct connection to lubricating systems for continuous or intermittent by-pass recirculation. For use with lube oils below 130° F. or above 200 S.U.S. heaters are suggested for best results. Installation is made on the pressure side of the lubricating system and the flow through the filter may be regulated by an inlet orifice. The size of this orifice is determined by the operating characteristics of the engine and the desired rate of flow through the filter as well as the viscosity of the oil. An installation such as this operates at a constant applied pressure. In case the oil pressure is lower than 20 psi. an oil pump is recommended in place or the orifice. Maintenance for this series filter is relatively simple. The filter is first drained, the cover removed, cartridges replaced, cover put on and filter filled. That is all there is to it. Hilco cartridges are interchangeable—repackable or throwaway, Hiltex (cellulose) or Hilite (Fullers earth). The cellulose cartridges have slightly more flow capacity than the fuller's earth although the latter have better adsorptive capacity for acid contaminants.

The "C" Series of Hilco filters are specially designed for high flow rates encountered in stationary and marine diesel engines ranging from 100 to 10,000 hp. This type may be used for full flow filtration with the largest unit capable of handling 270 gpm. at 170 ssu. through eighteen cartridges with a maximum pressure drop of 30 psi. This series uses replaceable or throwaway cartridges of the same basic type as the standard series.

The "R" Series filters are suitable for by-pass filtering only. They are suitable for smaller installations than the series "C" filters, there being only one or two cartridges in each filter case. However, multiple installations of these filters arranged in parallel makes for long element life. The single unit filter is recommended for 30 gph. capacity. The cartridge size is 7¼ in. by 18 ins. and is easily replaceable. The filter cover assembly contains a relief valve, a cartridge hold down spring, and air vent and wing nut. Cartridges are available in both cellulose and fullers earth types for this series.

The Series "N" filters are approved for Navy use in shunt or by-pass filtration systems. They are heavy duty units with a heavy bolted head construction to withstand 150 lbs. pressure. They are suitable for engines up to 2000 hp. The largest unit contains 8 cartridges with a capacity, on a shunt system, of 225 gpm. with oil at 170 ssu. and an operating temperature of 140° F. On a by-pass arrangement the recommended flow rate is 12 gpm.

Hilliard recommends these cartridge type filters in installations where there is little fuel oil or water in the lubricating oil system. For removing solid matter and acid contamination Hilite (fullers earth) cartridges are recommended. Where there is little or no acid formation, Hiltex (cellulose) are specified. The type of fuel and lubricant used, and operating conditions have a large part to play in the production of corrosive acid elements in the lubricating oil. The Hilliard Corporation has developed two lube oil reclaimers for the removal of contaminants in group two above. These are fuel dilution, water, dissolved gases and other volatile contaminants. These units are designed for continuous or intermittent purification by direct connection to an engine lubrication system. For filtering straight mineral oil, Hilite (fullers earth) is used, while for additive type oils, "Adstay" filter discs are utilized.

The first of these units, the Hilco Oil Reclaimer can be hooked up directly to engine lubricating system or can be used for batch reclaiming. Essentially, it is a miniature refinery. The dirty oil pump delivers dirty oil through a heat exchanger where it is warmed by hot outgoing oil, through an electrically heated preheater, and into a filter bed through which the oil is drawn by vacuum. The filter removes all solid matter and neutralizes acid combinations. The filtered oil next passes through a vaporizer. Heat is applied by a thermostatically controlled electric heater, and a vacuum is drawn by a vacuum pump. The vacuum process provides a highly efficient means for removal of moisture, and other volatile contaminants which have a lower boiling point than the oil. These impurities are condensed in a distillate tank or exhausted to the outdoors.

Hot purified oil returns to the heat exchanger in which it is cooled by the cold incoming oil, then to the clean oil pump which delivers it back to the lube system. Reclaimer models are built with capacities up to 24 gph.

The second Hilco reclaimer is the Airline Oil purifier. This unit has the same essential features as the one described above but has some additional recommending points. Oil is automatically metered and drawn into the heater tank by vacuum. The same is true of the fullers earth or other filtering material. An agitator keeps oil and filter medium in constant motion together allowing more rapid absorption of contaminants by the filtering medium. When a predetermined temperature is reached the heat is automatically turned off and the batch is ready to filter. The oil and filtering material then drains to the rundown tank where it is forced by air pressure through a filter press which retains the filter media along with the solid contaminants and delivers the oil, clean, to the outlet. The largest Airline purifier is rated at 50 to 60 gallons per batch with each batch taking from 45 to 60 minutes.

Lodge Pole Diesel Plant Sets The Pace

By T. J. MALONE

LODGE POLE, a community of about 500 on the main line of the Union Pacific Railroad in Nebraska, is so set on retiring from earnings the balance of debt on its $88,000 municipal diesel electric plant — $38,000 at this writing — that it charges for all services of energy, except one. It even charges the village itself for street lighting and water pumping, services that are often supplied "free" by municipal generating plants.

The one-uncharged-for service in Lodge Pole is a good-will gesture indicative of the spirits of its people and marking the plant as socially minded and a good citizen. When you attend a church party in Lodge Pole, you share in the enjoyment of a gift by the whole community. The light plant supplies energy to three churches without charge, the year round, for lighting, cooking, refrigeration, fans, vacuum cleaners.

For street lighting and water pumping, the village council transfers yearly from the general fund to the light fund 2.5 cents a kilowatt hour for whatever volume used. G. H. Emanuelson, plant superintendent, says the transfer has always been enough to cover the cost to the plant.

The electric plant's generating equipment consists of three Fairbanks-Morse engine units, of total 495 hp. and 317 kw. rated capacity. As against a peak load of 160 kw. in the latest operation year, 1947-48—May 1 of one year to April 30 of the other inclusive—the plant had a reserve capacity of close to 100 per cent.

Output in the latest year was 565,480 kw. hours of energy, the highest in the 37-year history of the plant. This was nearly double the output of 1944-45—it was 36.6 per cent more than the average of the three years just before it, and 30 per cent more than the output of 1946-47. The increase was spread fairly generally through all kinds of service.

Lodge Pole looks back to a time, beginning about 1911, when the generating equipment was a gasoline engine and a belt-driven generator, giving broken service and none after midnight. A 50-horsepower F-M diesel engine replaced the gas one after three or four years. In 1927, a second F-M diesel was installed and 24-hour service begun. Twelve years later a third diesel, also F-M, was added, replacing the 50-hp unit. The fourth and latest diesel went into operation in August, 1947.

The three units in today's setup are, in horsepowers, 120—150—225, and in kilowatt potentials. 72—97—148.

In the first full operation year of the 120- and 150 kw. units, 1940-41, output totaled 252,820 kw. hours. (Population of Lodge Pole by 1940 census, 479). Production kept under 300,000 yearly through the next four years with kilowatt-hour volumes of 250,620; 282,830; 281,790 and 295,870, respectively. Then the plant really struck its stride with 349,730 kw. hours in 1945-46, 434,820 in 1946-47 and the half million plus in 1947-48.

Generation cost in that latest year averaged 1.5 cents a kw. hour. Cost per kw. hour delivered at the consumer's meter averaged 2.44 cents, based on total volume generated. Average revenue per kw. hour was 2.91 cents, computed from net energy sales and total volume generated. Output of energy that year averaged 11.5 kw. hours to a gallon of fuel oil.

Care of the generating units has included regular inspection and cleaning. In 1937, the 120-hp. engine was supplied with rebored cylinders, new oversized pistons, new cylinder heads and new nozzles. Included in the plant equipment are Woodward governors, Burgess and Airmaze air filters, Alnor pyrometer and a Young enclosed radiator system insures proper cooling water.

Revenue bonds have financed the purchase of the present three engine units. Bonds against the first two have been retired. Two $1,000 bonds fell due July 1, 1948. Members of the council—C. H. Johnson, A. C. Bale, Charles Wise, Harold Kreider and L. J. Merek—as directors of the plant, were ready. They not only paid the $2,000 from surplus earnings but, for good measure, took up a third $1,000 bond that was not due but callable.

Even so, increasing costs of generating energy, owing largely to fuel oil prices, which had more than doubled, were cutting down the operating profit and pointing the need for more revenue to maintain the plant's ledger standing. To meet the situation a 20 per cent increase, effective January 1, 1948, was imposed on all monthly private-consumer bills. Bills continued to be made out on the schedules in effect since July, 1939.

There are three schedules, A and B for residence and commercial lighting, and C for power.

Schedule A reads: first 20 kw. hours, $1.75; next 8 cents a kw. hour; minimum, $1.75.

Schedule B reads: first 75 kw. hours, $3.25; next 125, 4 cents; excess, 2 cents; minimum, $3.25.

For C, the rate is 4 cents for the first 200 kw. hours; excess, 2 cents; minimum, $3.25 (including from one to three hp). For all over 3 hp. and up to 10, the minimum is $1.00 per hp.; for 20 hp. and over, it is $10.00.

A consumer using more than 38 kw. hours a month should go on Schedule B.

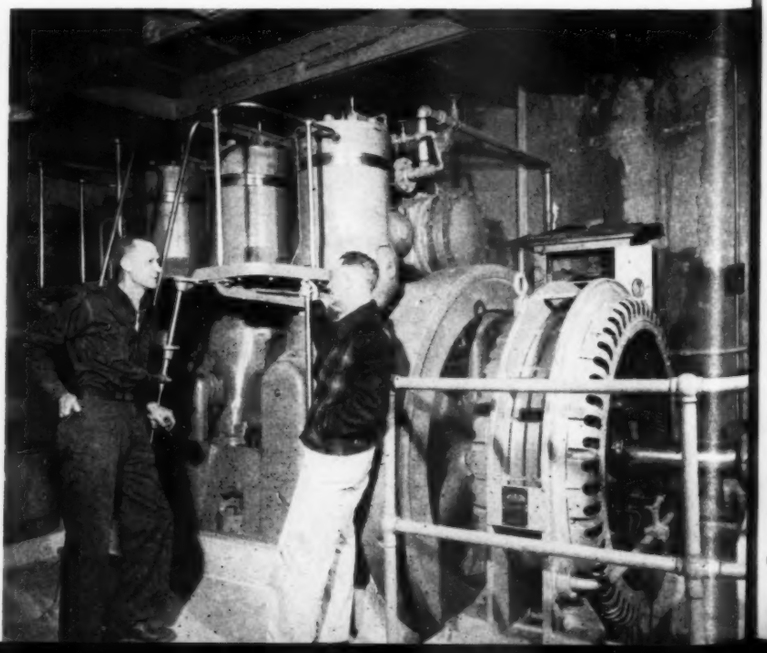
Back in 1931 the rates for both residence and commercial lighting were 15 cents for a first 10 kw. hours and 10 cents for excess! A bill for 65 kw. hours then would have amounted to $7.00. A corresponding bill today would total up, on Schedule B, $3.25 plus 20 per cent, or $3.90.

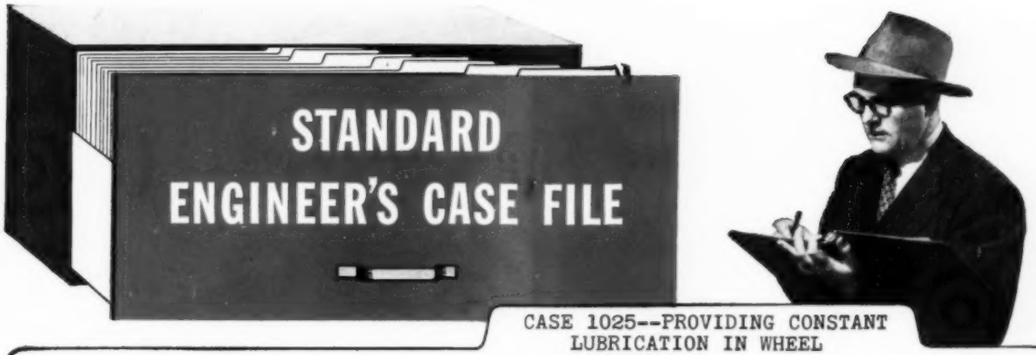
Consumers on the power rate include two grain elevators—this is in the winter wheat section of Nebraska—a locker plant, a service garage and a blacksmith shop.

How small a town, of what minimum population, can make a success of a municipal diesel electric plant? There seems to be no minimum.

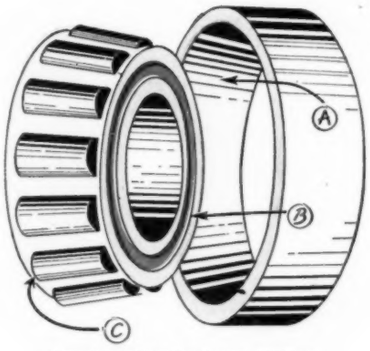
Below: The building in Lodge Pole, Nebraska, housing both electric and water department.

Right: The 3-cylinder, 148-kilowatt Fairbanks-Morse diesel engine, with Plant Superintendent George H. Emanuelson, right, and his brother, Charles E., a fellow operator.





CASE 1025--PROVIDING CONSTANT LUBRICATION IN WHEEL BEARINGS.



AUTOMOTIVE ROLLER WHEEL BEARING

Wheel bearings in trucks hauling heavy loads in desert heat, winter cold and rain, were in perfect condition long after usual servicing periods when the bearings were lubricated with RPM Wheel Bearing Grease. Recommended for all sizes and types of wheel bearings. Apply to bearing assemblies by hand or with mechanical lubricators.

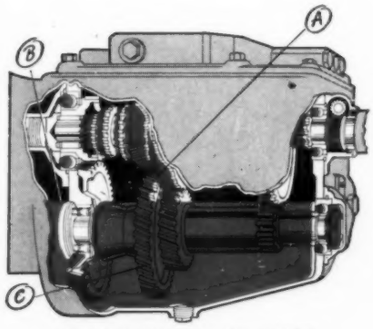
A. Maintains tough, resilient film on bearing surfaces - protects during constant pounding of road shocks and under overload pressures.

B. Feeds slowly to bearing parts ... resists extreme temperatures - will not melt and run from hubs onto brakes.

C. Stays in smallest bearing clearances.

RPM Wheel Bearing Grease provides good lubrication in the presence of water.

CASE 1029--REDUCING WEAR IN CONVENTIONAL AND WORM GEARS.



TYPICAL AUTOMOTIVE TRANSMISSION

Compounded RPM Gear Lubricant satisfactorily met all operating conditions in these gears in cars, trucks and similar machines. Comes in four grades: SAE 80, 90, 140 and 250. (For hypoids, use RPM Multi-Service Gear Lubricant.)

A. Compounds help resist high temperatures and pressures on gears. Minimize deposits and thickening. Make it non-corrosive to metals in gears and cases.

B. No foaming and leaking trouble - contains most effective foam inhibitor known.

C. High affinity for metal maintains lubricating film at all times. Constant oil wedge at gear contact points prevents scoring and extra wear.

RPM Gear Lubricant (Compounded) resists viscosity changes ... allows easy shifting in low temperatures and fast flow of lubricant onto gears.

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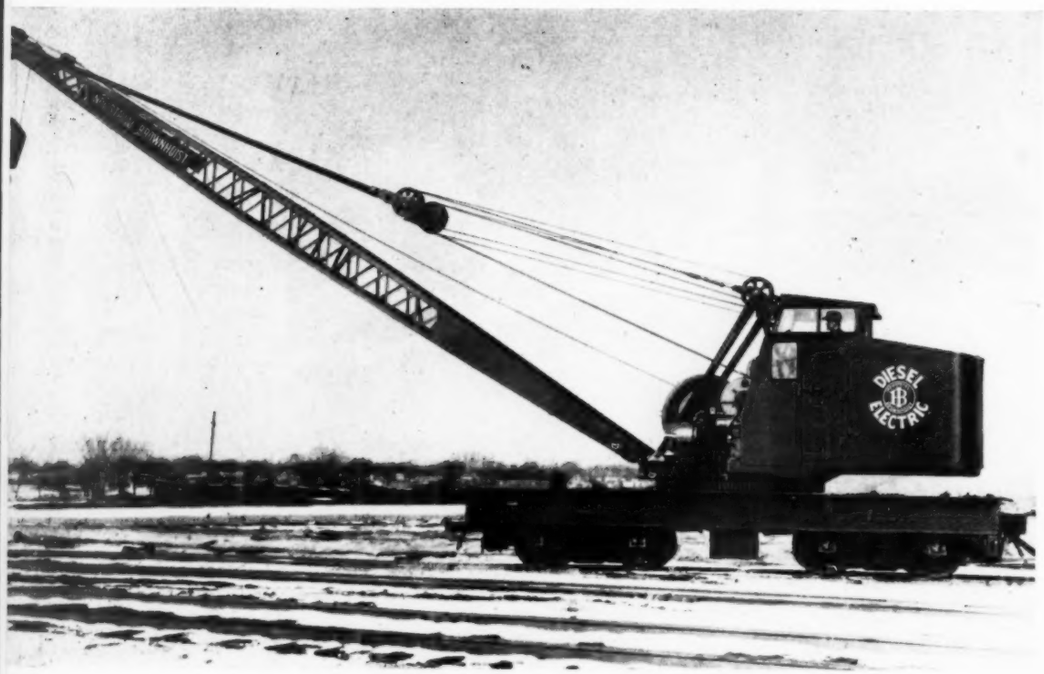
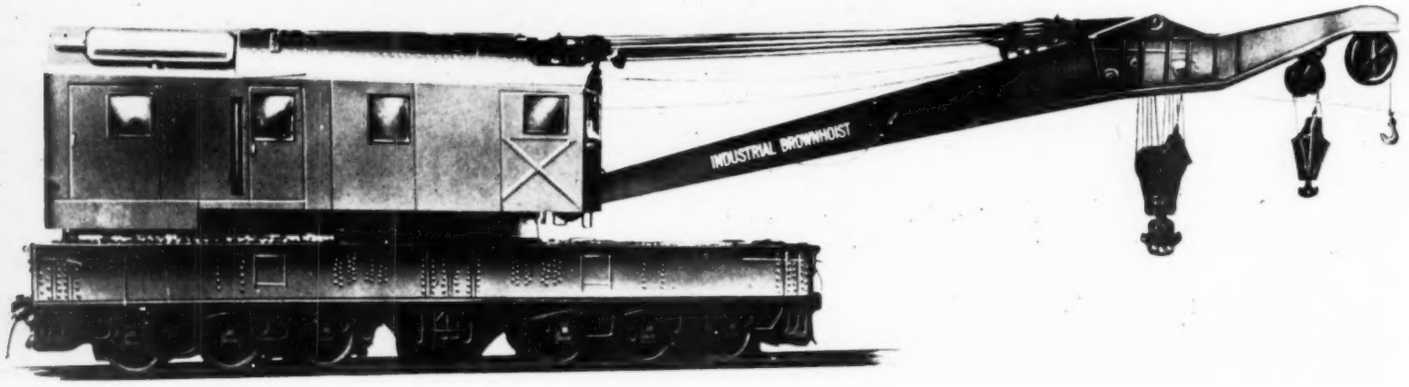
NEW DIESEL RAILROAD CRANES

250 ton giant for Norfolk & Western Railway



(Above) Brownhoist railroad crane built with Cummins or Hercules diesels installed driving General Electric generators and motors.

(Below) Two 150 hp. Cummins diesels drive this 250-ton wrecking crane. Crane was recently delivered to Norfolk & Western Rwy.



THE first 250-ton diesel powered Wrecking Crane, largest in the world, has been completed by Industrial Brownhoist Corp. In acceptance tests performed recently at the Brownhoist plant for officials of the Norfolk & Western Rwy., the huge crane demonstrated its tremendous power and ease and safety of operation, and afforded railroad representatives an opportunity to view at first hand its many engineering and construction improvements. It is powered with two 150 hp. Cummins diesels driving through Twin Disc hydraulic torque convertors. The design improvements are significant in their application.

These include ten conical rollers, installed front and rear. There are two sets of rear rollers. The upper pair is flanged and supports the weight of the rear end of the crane, utilizing the upper roller path of the baseplate casting. The four lower rear rollers are mounted in two alloy steel equalizers and carry the unbalanced tension due to the load and bear against the roller path. The four front rollers are flanged and arranged in two alloy steel equalizer castings to insure equal loading of all front rollers on their paths. All rollers are easily accessible for inspection, lubrication, and adjustment with shims to compensate for wear.

Another feature exclusive with the Brownhoist diesel driven Wrecking Crane is the selective two-piece slewing mechanism which operates through friction type clutches and a highly efficient worm and worm wheel.

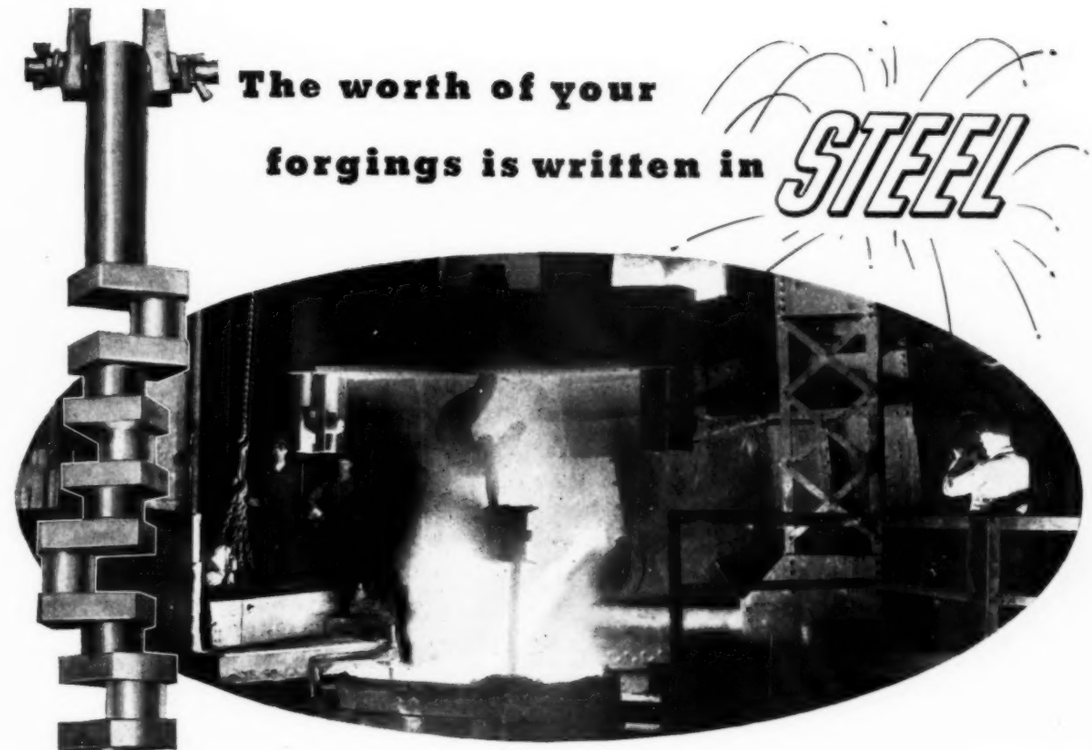
Boom-hoist mechanism is driven through a worm and worm wheel, designed to independently handle full rated loads. The worm drive, plus an automatic brake supplemented by an independent emergency brake insures positive reliability.

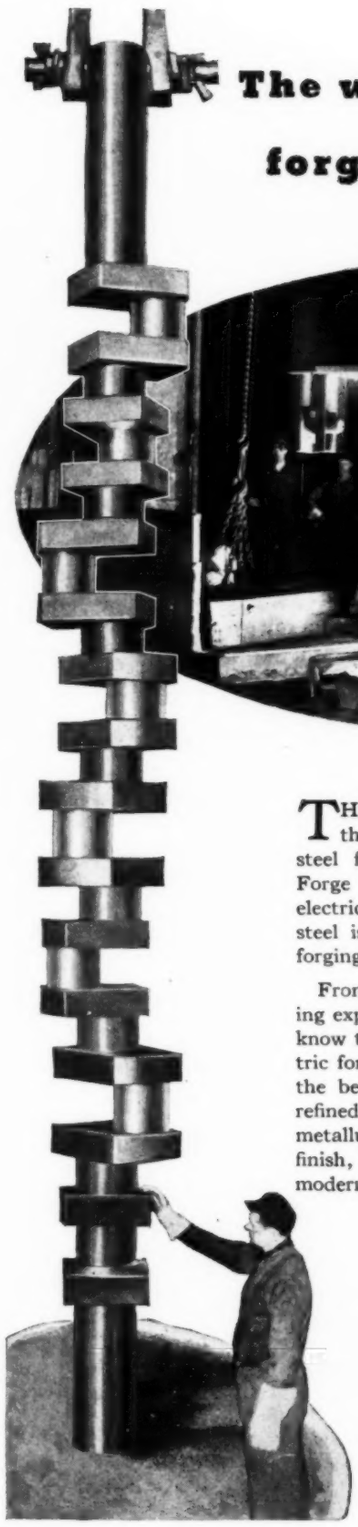
Cast steel machinery side frames of the crane are tied into a rigid unit by alloy steel operator castings which support the rollers. Two six-wheel steel side frame trucks carry the car body, permit free movement around 125-foot radius curves, and are designed especially to withstand heavy wrecking service.

Diesel-electric locomotive cranes capable of travel speeds up to 15 mph. and ruggedly built to perform heavy-duty switching operations as well as handle a wide variety of heavy loads, are another addition to the line of material handling equipment designed and built by Brownhoist. The new Brownhoist cranes are offered in capacities ranging upwards from 30 tons, depending on individual requirements. The diesel-electric combination permits the power to be transmitted directly to the axles by inside hung spring suspended motors eliminating travel gears shafting and clutches, and costly maintenance in heavy duty travel and shifting service. The combination unit, transmits the power for hoisting and swinging and booming directly to the superstructure through highly efficient helical gear reducer. Cummins or Hercules diesels and General Electric generators and motors are installed.

An important design feature of the Brownhoist diesel-electric locomotive cranes is the patented Monitor-type cab that affords the operator unrestricted visibility in every direction—360°.

The worth of your forgings is written in STEEL





THAT'S WHY—to be sure that the steel *is* right—you find the steel for each forging at National Forge individually melted in basic electric furnaces . . . for basic electric steel is the first "must" in making forgings of optimum quality.

From thirty-five years of steel forging experience, we at National Forge know there is no steel like basic electric for forging purposes. Made from the best raw materials, melted and refined by skilled men, controlled metallurgically from start to finish, all the art and science of modern steel making contribute to the high quality of National Forge basic electric forging steel.

So be steel minded when you order your forgings—and also remember that the forgesmithing, heat-treating and finish machining will be in exceedingly competent, well equipped hands when your steel forgings are National Forged.

Let us tell you the many critical reasons for insisting on basic electric steel, for it will pay you to know these facts as National Forge can give them to you from long-time steel forging experience.

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2 *more plants install* VAPOR PHASE

ENGINE COOLING AND WASTE HEAT RECOVERY SYSTEMS

WHY? Because *60 to 80 percent of every dollar* spent for fuel in an internal combustion engine, using a conventional cooling system, is *wasted!* VAPOR PHASE *saves* two-thirds of this waste heat and power for useful operation, and increases the mechanical efficiency of the engine as much as 10 percent!

THAT'S WHY the following two large plants have been added to an already long list of VAPOR PHASE users:

- **CITY OF FREEPORT, LONG ISLAND, POWER PLANT.** A VAPOR PHASE unit was installed in February 1948 on one of their 3000 H. P. 2-cycle Diesels. This installation was so successful that another VAPOR PHASE unit is being installed on a second 3000 H. P. Diesel and one new 3800 H. P. 2-cycle Diesel.

  These VAPOR PHASE units are the "LS" or Evaporative Type requiring no cooling towers or heat exchangers, as the heat is used in winter for space heating and discharged to the air in summer time. The small amount of water thus wasted in the form of live steam is replaced with treated plant water.

- **CITY OF LOS ANGELES POWER PLANT (Sewage Treatment System.)** Contracts have been let to install nine Turbo-charged Dual-fuel Diesels totalling 15,000 H. P. Fuel will be sewage sludge gas, with Diesel oil for pilot injection.

  The VAPOR PHASE system will cool all these engines and, at the same time, recover all heat from the engine circulating water, plus one-half of the exhaust heat. This heat, in the form of low pressure steam at 10 p.s.i.g., will be used to heat sewage sludge in the digesters. The steam used will be replaced with treated make-up water. 72 percent of the heat in the fuel will be utilized as a result of VAPOR PHASE Engine Cooling and Waste Heat Recovery.

  Since VAPOR PHASE operates the engines at boiling temperature, under all conditions of load and ambient, it is unnecessary to employ gas scrubbers which otherwise are required to remove harmful substances from the sewage gas.

SIMPLE, FOOL-PROOF, ECONOMICAL

VAPOR PHASE is simplicity itself. Uniform temperature is automatically maintained—the human element eliminated. VAPOR PHASE is absolutely safe—it has never damaged an engine. It even permits the use of untreated acid fuels with a high degree of efficiency, without harmful effect. VAPOR PHASE equipped engines serve the multi-purpose job of generating electric power, heating water or other fluids, heating space or other process—all at the same time, at one low operating cost!

VAPOR PHASE PAYS FOR ITSELF

in actual fuel and waste heat savings alone, in approximately one year, often less. Additional savings accrue in engine maintenance, lube oil and oil filters.

3 *Types of* VAPOR PHASE FOR STATIONARY AND MARINE ENGINES

VAPOR PHASE units, for commercial, industrial and marine use, are supplied in the following three types:

- **SMALL UNATTACHED TYPE for cooling engines up to 200 H. P.**
- **"LS" TYPE for cooling and waste heat recovery up to 7000 H. P.**
- **"W-C" TYPE for cooling only or for heat recovery, using water or other liquid to condense the steam, Sizes up to 750 H. P.**

DELIVERIES—Shipment of most sizes can be made within 30 to 60 days following receipt of order.

Endorsed by City and Consulting Engineers and Engine Manufacturers—In use Since 1939.

VAPOR PHASE Engine Cooling and Waste Heat Recovery Systems are available for any size or type of engine.

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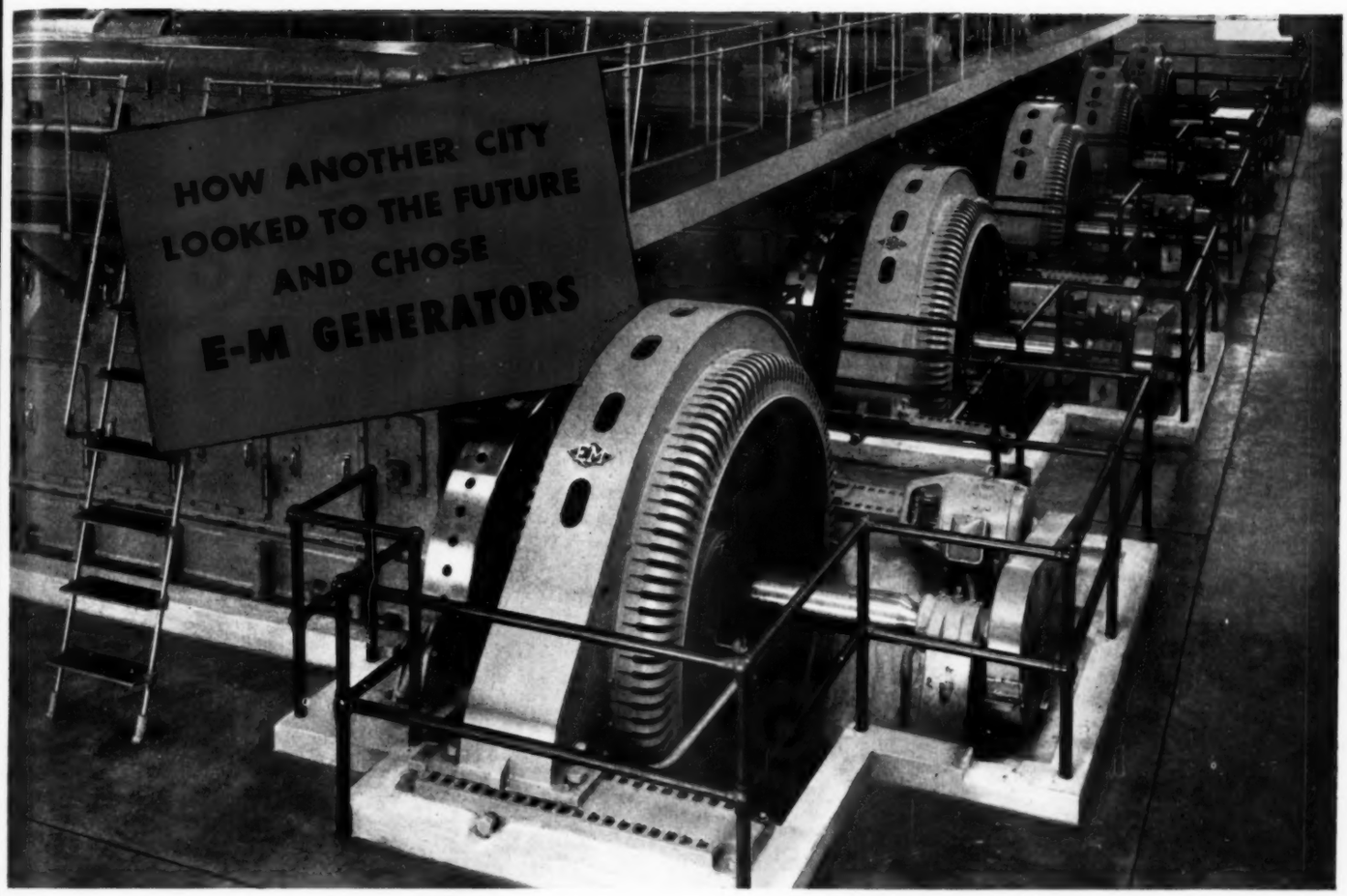

Now, the lights stay on in New Bern

The need for a dependable and economical source of electric power was brought home to New Bern, N. C., during the war.

Rapid power plant obsolescence and growing power consumption made the threat of a power shortage a real and serious thing to the 20,000 inhabitants of the old, southern city. With the end of the war in 1945, the city acted to secure the recommendations of an engineering firm to end this threat. The picture shows the answer to the problem—five E-M 1000 kw generators operated by five 1430 hp diesel motors. Basing their choice on the experience of other cities, the New Bern aldermen themselves participated in selecting generators made by the Electric Machinery Mfg. Company.

This story hits at the heart of the reason why such a large proportion of generators being installed today are E-M built.

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When events emphasize the need for generators that will operate year in and year out with minimum maintenance, E-M generators become an obvious choice.

For these generators are built by an organization that has specialized in power plant problems since the beginnings of the electric power industry . . . ruggedly built from their rolled steel, welded frames to their multi-layer coil insulation. They are up-to-the-minute and reliable in every detail of construction . . . individually engineered to the precise requirements of the installation . . . easy to clean and maintain.

Write for our publications explaining in detail the important advantages of E-M generators. Or call on one of our field representatives, all of whom are electrical engineers.

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• Oil sample from an Ingersoll-Rand 800 h.p. type KVG after 7,076 hours of continuous operation. Laboratory analysis shows neutralization number of .06, with excellent color.*
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● Illustration of oil sample above is typical of the results obtained with Honan-Crane Oil Purifiers. By removing all types of contamination, both solid and soluble, Honan-Crane Oil Purifiers make it possible to get maximum lubricating efficiency and longest life from lubricating oils. *Example illustrated shows clarity of oil after 7,000 hours of use with Honan-Crane Purifier. Laboratory analysis proves this oil to be in excellent operating condition.*

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News OF THE INDUSTRY

Marine Conference Program

PLANS for the holding of the American Merchant Marine Conference and the Twenty-second Annual Convention of The Propeller Club of the United States, New York, were announced by Honorary President Arthur M. Tode of the organization. The dates for the annual gathering of the marine industry are October 13th, 14th, and 15th in the Waldorf-Astoria. Chairman of the Conference is Mr. J. Lewis Luckenbach, President of the American Bureau of Shipping, and the Presiding Officer at the Conference will be Vice Admiral William Ward Smith, Chairman of the United States Maritime Commission.

The Annual Luncheon of the Conference will be held in the Grand Ballroom of the Waldorf-Astoria on Thursday, October 14th, the speakers being:—Vice Admiral W. W. Smith, Chairman of the United States Maritime Commission, Mr. Frazer A. Bailey, President of the National Federation of American Shipping, and Mr. H. Gerrish Smith, President of the Shipbuilders Council of America.

Some twenty-five round-table or Panel Discussions will be held during the three-day period under the auspices of various marine associations.

DEMA Panel To Be Held At American Merchant Marine Conference

ON Thursday, Oct. 14, 1948 a panel titled "User Experiences with Diesel Engines" will be held by the Diesel Engine Manufacturers Association at The Waldorf-Astoria Hotel, New York City. The panel, starting at 9:30 a. m., will be held for the American Merchant Marine Conference which is to be conducted by The Propeller Club of the United States.

Acting as chairman of the panel will be Gordon Lefebvre, president of the Diesel Engine Manufacturers Association and president of The Cooper Bessemer Corporation. Otto H. Fischer, vice-president of the Diesel Engine Manufacturers Association and president of The Union Diesel Engine Company, will be co-chairman.

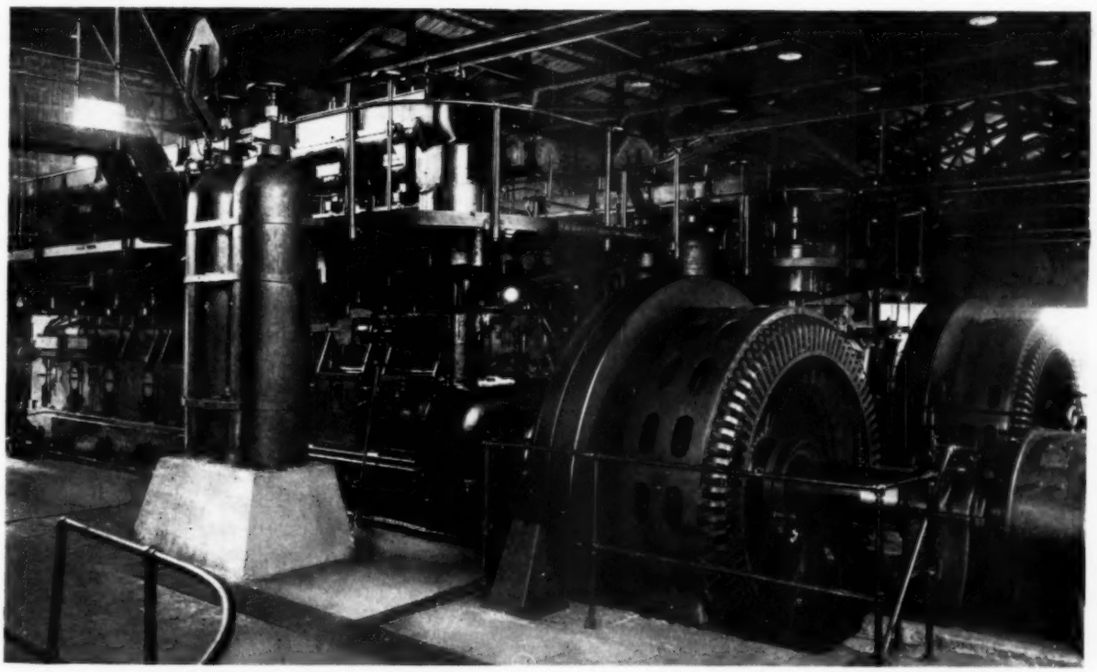
Harry B. Jordan, president of Canal Barge Company, will tell of "The Future Use of Marine Diesel Engines in the New Orleans Area." A. J. Dawson, chief engineer of Dravo Corporation's marine department, will talk on "The Future Use of Diesel Engines in River Traffic."

Captain George F. Hicks, chief of the naval engineering division of the U. S. Coast Guard, will have as his topic, "The Future Use of Diesel Engines by the U. S. Coast Guard."

Brian P. Emerson of Diesel Publications, Inc., will speak on "Present and Future Applications of Diesel Engines in the Marine Field."

"Future Use of Diesel Engines by the U. S. Navy" will be discussed by Captain Lisle Small, executive engineer of the Lima-Hamilton Corporation.

Peace of Mind...
FOR DIESEL ENGINEERS



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OPERATING and maintenance headaches make life tough for engineers... make operators wish they had a friend. That's where GASCON OIL comes in. It *makes life easier* for the Diesel engineer.

Inherent qualities in the basic crude give Gascon *natural ability* to clean engines and keep them clean . . . to wash away and disperse carbon and crankcase accumulations.

The effect of these qualities on Diesel operation gives engines longer time between tear-down . . . more continuous operation time . . . lower maintenance cost . . . more efficient operation.

Let us discuss Gascon Oil with you in relation to your operating requirements.

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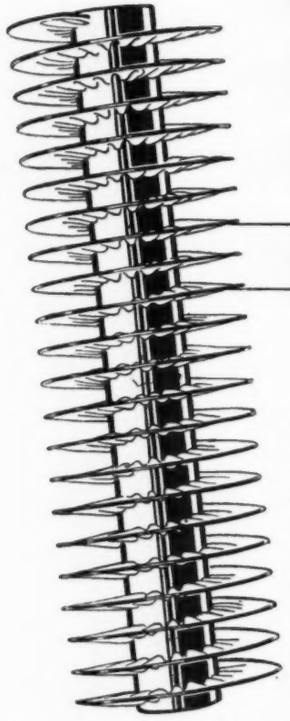

YOU can crowd a lot of cooling capacity into limited space with Aerofin fin-type coils. Installation can be made strictly according to Aerofin's accurate ratings. And perfect bonding and complete tinning assure maintenance of full ratings throughout the life of the installation. An Aerofin engineer is available to help you.

★ *Aerofin is sold only by manufacturers of nationally advertised fan system apparatus. List on request.*

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Prime Mover Control Conference A Success

THE Woodward Governor Company held the twelfth Prime Mover Control Conference September 13th to 17th at the company plant at Rockford, Ill. Over 80 engineers and operators met to discuss governor problems and find out the latest developments in Woodward governing equipment for diesel engines and waterwheel equipment. Emphasis was placed on the discussions of diesel locomotive governors at two special meetings. Engineers attended from all parts of the United States and Canada.

Diesel Oil Filtration Discussed at Cuno Sales Conference

AT A recent sales conference held at Pine Orchard, Conn., members of the Cuno organization met to discuss Cuno Filtration systems and their application in industry.

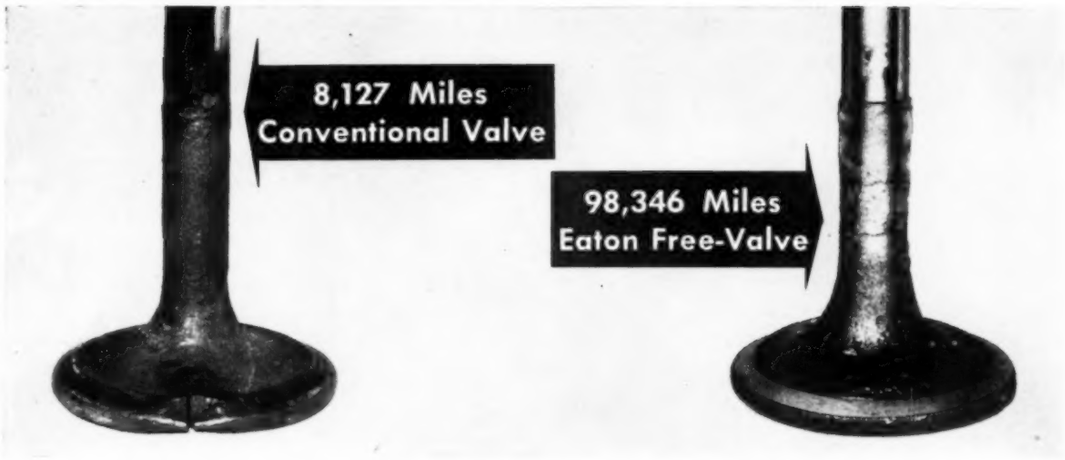
The four day meeting of Cuno Sales representatives opened with a welcome by C. H. Winslow, Sales Manager of the Cuno Corporation and a short talk by C. H. Cuno, President of the company. The real business got underway Tuesday when H. Thomson gave a detailed report on the development and manufacture of the Micro-Klean filter. J. A. Plummer followed this talk with a presentation of a motion picture showing the production of the Micro-Klean cartridge.

Tuesday's meeting was highlighted by a panel discussion of the application of Cuno's Auto-Klean and Micro-Klean filters in the filtration of diesel lube and fuel. Participating in this discussion were C. H. Winslow, Chairman, D. H. Van Vleck, J. A. Plummer, F. J. Ursem, W. A. Ursem and G. C. Halwas. Each member of the panel had some very interesting experiences to relate to the meeting concerning the filtration of diesel fuel and lube oil in the field and under test conditions. This diesel program was allotted more time than any other one subject and was of great value to the listeners, who commented at length on their individual experiences. The discussion was continued after dinner on Tuesday.

Wednesday's program included a discussion of the Cuno Flo-Klean filter by D. H. Van Vleck and a talk on the new features of the Auto-Klean filter by A. J. Kroll. The meeting ended Thursday, Sept. 16 after an interesting discussion on Sales Promotion by R. H. Keane, Sales Promotion Manager and B. A. Allis of Cuno's advertising agency.

Predict 150 MPH for Gas Turbine Locomotive

WALTER GIGER speaking before the fall meeting of the ASME described the design for a 3000 hp., 150 mph. gas turbine locomotive. Giger stated that the lowering of the center of gravity to four feet about the rails combined with the use of lightweight passenger equipment, properly streamlined should make high speed operation safe. The weight of the proposed gas turbine locomotive is about 270,000 lbs. Two trucks with two traction motors each will supply traction power to rails. Mr. Giger is consulting engineer for Allis Chalmers Manufacturing Company which company has pioneered in gas turbine development.



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eliminate valve failures between major overhauls

Eaton Free-Valves have completed more than 7 million miles, over a period of 4 years, in trucks and buses. The operations include various types of service and more than 100 vehicles of several different makes.

RESULTS:

VALVE LIFE . . . . . Increased to equal the mileage between major overhauls.

PERFORMANCE . . . Fuel consumption and power output maintained at new-engine level to major overhaul.

A complete report has been published in the latest issue of the Eaton Engineering Forum. Copies will be mailed upon request.

The operating principle of the Eaton Free-Valve involves simply a momentary release of spring load, permitting the valve to move in accordance with its natural tendency. Eaton Free-Valves are adaptable to all types of internal combustion engines and require no change in basic engine design. Eaton engineers will welcome an opportunity to discuss this device with engine and vehicle manufacturers.

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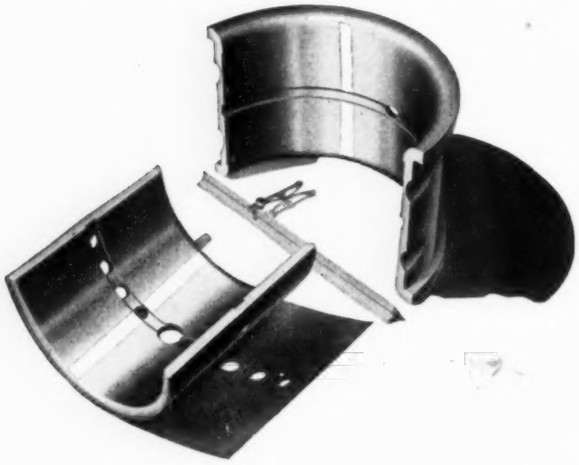
DIESEL BEARINGS



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Why does the majority of the manufacturers of diesel engines . . . including all of the leaders . . . get their bearings from Johnson Bronze? Simply because we give them the type of bearings they require . . . made to precise specifications . . . and delivered *on time.*

Johnson Bronze has much to offer the diesel manufacturer. We help you decide which type bearing will deliver the greatest performance for the longest period of time at the lowest possible cost. We base all of our recommendations on facts . . . free from prejudice. We give you the benefits of our more than forty years exclusive bearing experience . . . our highly trained and skilled personnel . . . our complete facilities for testing and experimental work.

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Spending for Road Building Will Break Records in 1948

AMERICA'S highway construction program should reach an all-time high in 1948, Charles M. Upham, engineer-director of the American Road Builders' Association, predicted in a conference with road officials recently. He based this belief on the uniform increases since 1945. "If the upward trend is maintained, we should hit the $1½ billion mark this year," Mr. Upham held.

"October is our peak construction month," declared Mr. Upham. "In October 1946, $100 million was spent in road building. In October 1947, this rose to $178 million. At this rate, October 1948 should show a total expenditure of $250 million.

"The yearly ratios show practically the same increases—from $772 million in 1946 to $1½ billion in 1947," the engineer-director continued. "At our annual convention and road show held in Chicago, contractors and highway officials expressed confidence that the 1948 total would approximate $1,750,000,000.

"According to the Federal Works Agency, contracts by state highway departments for the first five months of 1948 amounted to 38 per cent more than the corresponding period of 1947. Federal aid contracts awarded in May of this year were 30 per cent higher than those awarded in May 1947. State highway contracts awarded in May 1948 were 31 per cent above those of May 1947, and total highway contracts at all government levels for May 1948 were 41 per cent over those of May 1947. These substantial gains in road building expenditures justify our optimistic view," Mr. Upham went on to say.

Citing figures from the U. S. Department of Commerce, Mr. Upham pointed out that construction in all categories, public and private, was expected to reach a record figure of $18 billion in 1948. This figure will be $4 billion higher than the record established in 1947, and $4½ billion over the previous high reached in 1942.

All In A Day's Work

Heaping a 14-yard struck capacity scoop with 17 yards of yellow clay soil while traveling up a 15 per cent grade, operator Bob Adam of Omaha and his International TD-24 crawler tractor move an average of 1200 yards every eight hours on a quarter-mile haul loading both ways. The big diesel handles this job in Douglas County, Nebraska unassisted, in third gear.

Order Your Copy of the 1948 DIESEL ENGINE CATALOG, Vol. 13 now. Thoroughly revised — more complete — indispensable. Convenient order coupon on page 98 this issue. Mail it today.

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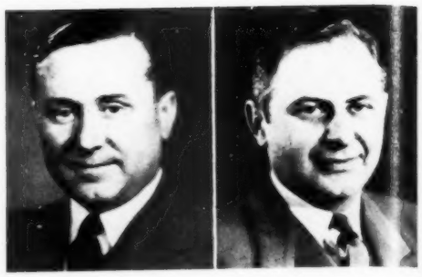
Names IN THE NEWS

Baldwin Announces New Appointments

THE Baldwin Locomotive Works recently announced that Lewis W. Metzger, Vice President, has been made Executive Assistant to Marvin W. Smith, Executive Vice President, and will assist Mr. Smith in all phases of Baldwin's operating activities.

Announcement also was made of the appointments of James R. Weaver as Manager of Manufacturing, Eddystone Division, and John S. Newton as Manager of Engineering, Eddystone Division. Both Mr. Weaver and Mr. Newton come to Baldwin from the Westinghouse Electric Corp.

Mr. Weaver's first Westinghouse assignment was at East Pittsburgh with the Westinghouse Machine Company. One of his first major positions was that of Superintendent of Manufacturing Equipment. Later he became Director of Equipment, Inspection and Tests, a position he occupied until he assumed the responsibility for the operation of the U. S. Naval Ordnance Plant at Louisville, Kentucky during the war. Since the war, Mr. Weaver has been in charge of all manufacturing operations at the Westinghouse plant at Springfield, Massachusetts.



J. R. Weaver J. S. Newton

Following his graduation from Oregon State College in 1930, Mr. Newton spent the first nine years of his career with Westinghouse at East Pittsburgh where he was engaged in the design and application of large DC machinery. For the past nine years he has been located in the Steam Division at South Philadelphia where he had the position of Assistant Engineering Manager.

James Boyd To Hamilton Division

JAMES BOYD, formerly eastern district manager of the Westinghouse Electric Corp., has been appointed general sales manager of the Lima-Hamilton Corporation's Hamilton Division, it was recently announced by George A. Rentschler, chairman of the Lima-Hamilton executive committee.

A native of Edgewater, N. J., Mr. Boyd grew up on Staten Island, and now lives in Summit, N. J. He was graduated from Pratt Institute in 1917 and joined Westinghouse the same year as service engineer. In 1920 he went into the firm's New York office as a salesman in the general industry section. in 1925 he was promoted to the post of supervisor of the general mill section, and in 1935 he became eastern industrial manager. He was made assistant eastern district manager in 1937, and he became eastern district manager in 1938.

James Boyd

National Supply Names Wilson

J. G. WILSON has been appointed regional manager at Fort Worth, Texas, the Superior Engine Division of The National Supply Company has announced. Mr. Wilson succeeds A. B. Reese, Jr., who has been made chief oil field engineer for the Superior Engine Division. An alumnus of the University of Wisconsin, Mr. Wilson joins The National Supply Company after nine years of specialized diesel sales work in the Middle West.

Price Named By Penn Electric

E. A. PRICE has been appointed manager of the New York District Office for Penn Electric Switch Co. according to an announcement by R. H. Luscombe, general sales manager of the company. He succeeds N. E. Jennison who resigned to enter the wholesale refrigeration business.

OCTOBER 1948

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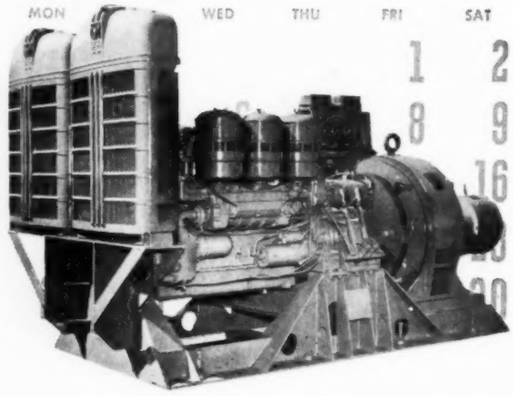

BFM

POWER UNIT OF THE MONTH

150 KW twin BFM generating set for New York's new International Airport. Automatic controls on both GM 6 cylinder diesels enable unit to start within 15 seconds after power failure.

Below, a condensed list of outstanding diesel power units available at discounts as high as 66⅔% off list. Some government surplus units others of BFM design and construction.

		PHASE	VOLTS	R.P.M.
		AC 60 CYCLES		
3 KW	Witte	1	120	850
5 KW	Witte-Hobart	1	110	720
7.5 KW	Witte-Hobart	3	220	720
20 KW	Hercules D00C	1	220/440	1800
25 KW	Chrysler	3	220/440	1200
30 KW	Chrysler	3	220/440	1800
75 KW	General Motor	3	220/440	1800
250 KW	General Motor	3	220/440	1200
300 KW	Cooper Bessemer	3	220/440	900
325 KW	Cooper Bessemer	3	220/440	900
		DC		
2 KW	Stover	110 volts		900 R.P.M.
20 KW	General Motor	110 volts		1200 R.P.M.
30 KW	General Motor	110 volts		1200 R.P.M.
125 KW	Buckeye	110/220		600 R.P.M.
150 KW	Buckeye	110/220		600 R.P.M.
300 KW	Cooper Bessemer	240		900 R.P.M.

Complete details and prices on the above are yours on request. Write or phone —

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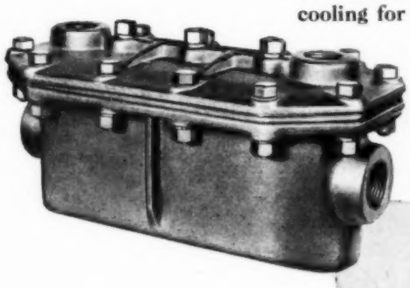
Heat Exchangers

Step Up Operating Efficiency

Diesel-powered fishing vessels are bringing new efficiency to an old trade. The modern craft have a cruising range up to 10,000 miles, and are complete with quick-freezing refrigeration systems, mechanical hoists and pumps and other time-saving machinery.

Harrison equipment helps to maintain efficiency on these highly mechanized vessels. Oil temperatures of the propulsion Diesels are maintained within the proper range by Harrison oil coolers. Other Harrison heat exchanger units provide effective cooling for auxiliary engines, generators, pumps and machinery.



Harrison is well qualified to recommend the answer to your particular cooling requirements. Write to Harrison Radiator Division, General Motors Corporation, Lockport, New York.

HARRISON

OIL COOLERS AND RADIATORS

McGuigan Named by USMC

APPOINTMENT OF Captain Joseph Lloyd McGuigan, USN, as acting chief of its Bureau of Engineering, was announced recently by the United States Maritime Commission.

Captain J. L. McGuigan

Captain McGuigan, who has been on detail to the Commission since December 1945 as chief of the Division of Small Vessel Sales, succeeds James L. Bates, who retired in September as technical head after 45 years in the government service.

A native of Wisconsin, Captain McGuigan was appointed to the United States Naval Academy from Oklahoma in 1910 and was graduated in 1914. After two years of duty afloat he started a course at Massachusetts Institute of Technology in 1916 which was interrupted for duty in World War I. He completed the course in 1920, receiving the degree of master of science in naval architecture.

Captain McGuigan was supervisor of shipbuilding during World War II for Tacoma (Wash.).

Tuthill Appoints Chapman

THE APPOINTMENT OF E. W. Chapman as vice-president in charge of engineering, has been announced recently by Mr. G. B. Tuthill, president of the Tuthill Pump Company.

Mr. Chapman is widely known in industry for his wide experience in the rotary pump field. Before joining Tuthill, he served in a similar capacity for Bowser, Inc., Industrial Pump Division, at Fort Wayne. Prior to this, he was associated with the Blackmer Pump Company, first as development engineer and later as chief engineer.

National Supply Company Names McKinney Executive Vice-President

Arthur W. McKinney

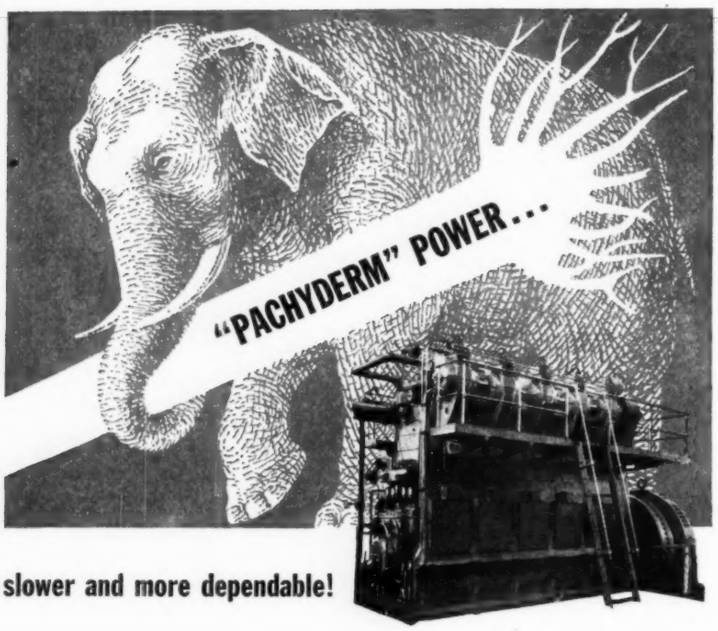
ARTHUR W. McKINNEY of Toledo, vice president and general manager of sales of The National Supply Company, was elected recently to the newly created position of executive vice president of the company. Mr. McKinney joined National Supply Company as a salesman in 1920 shortly after his discharge from the Army, in which he served as a lieutenant in the Signal Corps. He rose through various sales positions to become vice-president and general manager of sales in 1940.

A specialist in petroleum problems, Mr. McKinney held advisory positions in that field during World War II, serving as a member of Industry Advisory Council, Petroleum Administration for War; and member of Materials Subcommittee, Petroleum Industry War Council.

William F. Hart Dies

WILLIAM F. HART, 65, of The National Supply Company, who served as assistant to the chief of the industrial division of the Pittsburgh Ordnance District in World War II, died suddenly July 1 in a Cleveland hotel. He had been associated with National Supply since 1940.

Mr. Hart was president of the Verona Tool Works, Verona, Pa., from 1920 until 1927 when he resigned to become the first manager of Tubular Sales for the Bethlehem Steel Company. He resigned this post in 1931 to do research work for Weirton Steel Company.



slower and more dependable!

Fulton Diesels are deliberately designed to give you maximum power at minimum speeds. Lower RPM means less wear on moving parts... longer service... less maintenance costs... more work per gallon of fuel. Fulton Diesels more than thirty years old are still giving faithful service with remarkably low upkeep.

Look at the speed, when you look at diesels. Consider the cost per year of service... not the first cost alone! There's a big difference!

FULTON DIESELS

TYPE KS... 6 or 8 cylinders... delivering 1840 to 4000 HP at 240 to 257 RPM.

TYPE BGS... 5, 6, 7 or 8 cylinders... delivering 750 to 1980 HP at 257 to 277 RPM.

FULTON DIESELS—the best buy for the long run

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Check these gridded bearing features

NATIONAL BEARING assures you of all these important gridded bearing advantages...

CENTRIFUGALLY CAST—improves heat transfer, gives greater fatigue strength, insures conformability in the presence of shaft deflection, and increases wall-to-wall structural strength.

PRECISION SPACED GRIDS—centrifugally filled with silver babbitt metal to trap dirt particles, guard against shaft damage and seizure during periods of overstress.

LEAD BRONZE LANDS—also spaced to give the correct combination of structural strength, conformability and embeddability.

.002 LEAD TIN RUN IN SURFACE—increases resistance of bearing to corrosion and fatigue—helps to extend bearing life.

N-B-M Gridded bearings, with all four of these features, are the answer to high-speed, high temperature engine operation. During sudden periods of overstress or lack of lubrication, some of the soft babbitt in the grids automatically melts and flows to the affected area of the bearing—shaft scoring and seizure are minimized.

These Gridded Bearings are being applied to diesel engines and machine tools with outstanding results in maintenance savings—longer, more trouble-free service.

No bearing application is a "mail order" application—proper alloy, design, stress loading and lubrication are becoming more and more complex. 74 years of solid engineering background behind American Brake Shoe Research combined with National Bearing Division's manufacturing skill insures a thorough engineering approach to each bearing problem—how can it be designed and applied?...how can it be made more efficiently?... how can quicker delivery be made to the customer?

If you're asking the same questions about bearing problems, put this unique engineering service to work for you!

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NATIONAL BEARING DIVISION

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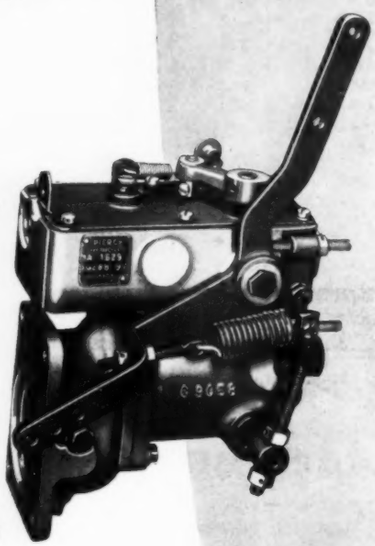
PLANTS IN: ST. LOUIS, MO. • MEADVILLE, PA. • NILES, OHIO • PORTSMOUTH, VA. • ST. PAUL, MINN. • CHICAGO, ILL.

PIERCE
GOVERNORS

-your answer to better Diesel performance



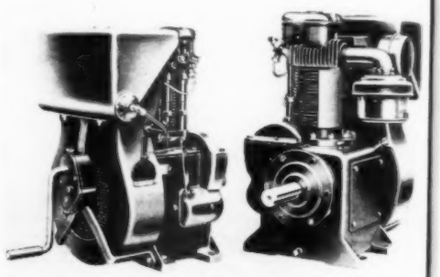
PIERCE GOVERNORS get the most from diesel engines. They are simple to install—in either right or left hand mounting. They are simple to adjust—with all controls immediately accessible upon removal of the governor lid. They provide extra rack travel to facilitate starting at low cranking speeds. They offer a simple shut-off device to eliminate much complex linkage often employed in stopping the engine. They provide torque control to increase lugging power. For all of these reasons, Pierce should be your first consideration in diesel engine governing.

THE PIERCE GOVERNOR CO., INC., 1603 Ohio Ave., ANDERSON, IND.

New Products

Hallett Sneak-Previews Air-Cooled Diesel at Chicago Road Show

Delegates and visitors to the American Road Builders Convention and Road Show at Soldiers Field in Chicago last month were enthusiastic in their acceptance of the new Hallett Low-Horsepower Air-Cooled Diesel Engine exhibited to the trade for the first time in Hallett's suite at the Hotel Sherman by William D. Brumbach, Hallett Sales Manager.



New 5hp. air-cooled Hallett diesel.

Hallett distributors from every country in the world attended Hallett's trade-preview and were unanimous in their statements that this 5 horsepower air-cooled Diesel filled a long-felt agricultural, industrial, and maritime need in making an economical source of dependable power available for locations where the lack of an adequate source of fresh water had previously been an obstacle. This new air-cooled Diesel will prove valuable in opening up extremely arid desert regions to small industry and wet farming.

"Casting the cylinder, cylinder head with its pre-combustion chamber, and cooling fins integrally eliminates the need for a gasket between the block and head, making possible the production of this first thoroughly dependable, highly economical, and practical air-cooled Diesel. Having no head gasket assures uniform cooling and eliminates hot spots," explained Mr. Brumbach. "The Hallett Manufacturing Company has completed its tooling and will be in full production on what is to be known as its 'Model AC-1' within the next sixty days and deliveries to distributors of record will begin November 1st."

Clean in design and appearance, compact and light in weight, with an extremely high horsepower-per-pound ratio, this Hallett Air-Cooled Diesel should find a ready market in both domestic and foreign fields.

For further details write Hallet Mfg. Co., 601 S. Redondo Blvd., Inglewood, Cal.

Order Your Copy of the 1948 DIESEL ENGINE CATALOG, Vol. 13 now. Thoroughly revised — more complete — indispensable. Convenient order coupon on page 98 this issue. Mail it today.

POWER TRANSMISSION EQUIPMENT

Brad Foote Gears

WORMS — Milled up to 12" dia. — up to 1 D.P.

WORM GEARS — Generated up to 108" dia. — up to 1 D.P.

HERRINGBONE GEARS — up to 60" P.D. 18" face, 2 D.P.

STRAIGHT BEVEL GEARS — Straight tooth — up to 60" dia., 10" face up to 4½" C.P.

HELICAL OR SPIRAL GEARS — Generated up to 108" dia., 16" face — up to 1 D.P.

SPIRAL BEVEL GEARS — up to 32" dia., 6" face, up to 1½ D.P.

HELICAL GEARS — Ground tooth up to 14" dia., 6" face, 2 D.P.

SPUR OR HELICAL GEARS — Shaved tooth up to 20" dia., 8" face, 2 D.P.

SPUR GEARS — Form Cut—to 96" dia., 24" face — up to 4" C.P.

SPUR GEARS — Hobbed Generated — to 108" dia., 18" face — up to 1 D.P.

SPUR GEARS — Fellows Generated—to 140" dia., 8" face, up to 1 D.P.

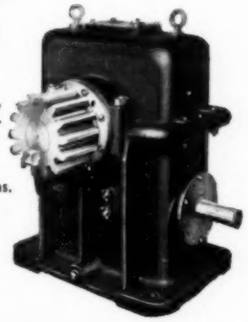
SPUR GEARS — Ground tooth up to 18" dia., 12" face — 2 D.P.

INTERNAL GEARS — Form cut up to 72" dia., 12" face — up to 1 D.P.

INTERNAL GEARS — Generated up to 120" dia., 8" face — up to 1 D.P.

ACME SCREWS — Milled up to 6" dia. 30 ft. length

SPEED REDUCERS



WORM GEAR
Ratios 3⅝ to 1 to 60 to 1 Single, Double Reductions up to 10,000 to 1.

HERRINGBONE GEAR
— Ratios 2 to 1 to 295 to 1 Single, Double and Triple Reductions.

GYRO — Ratios — 24 to 1 to 3600 to 1

OIL WELL UNITS 28.4 to 1
Double Reduction
Peak torque 24,750 lbs. to 69,500 lbs.

BRAD FOOTE GEAR WORKS

1309 South Cicero Avenue
Cicero 50, Illinois

Simply stated ... most effective de-greaser and de... It removes deposits by cold immersion ... thought impossible.

FORMULA 555 is safe on all metals ... cannot burn or explode ... contains no phenolic compounds ... has built-in seal ... rinses in plain water. FORMULA 555 is cleaning an amazing range of things such as water meters, heat treated parts, diesel injection jets, core boxes and dryers, oil filters, complete flush-out of engines, aircraft pistons, etc.

FREE DEMONSTRATION

Without obligation, a Kelite Service Engineer will prove the effectiveness of FORMULA 555 to you ... on your work. And remember, no shop is too small or too large for FORMULA 555. Just mail the coupon.

"KELITE" REG. U.S. PAT. OFF. • pH CHART COPYRIGHTED 1942 BY KELITE PRODUCTS, INC.

KELITE pH Control

SCIENTIFIC CLEANING THROUGH pH CONTROL

KELITE PRODUCTS, INC.
BOX 2917, TERMINAL ANNEX, LOS ANGELES 54

I am interested in seeing a free demonstration of FORMULA 555.

*Name*_____

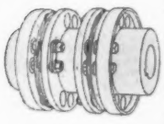
*Company*_____

*Street*_____

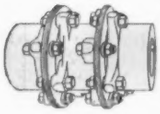
*City*_____ *State*_____

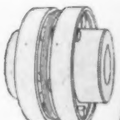
THOMAS
Flexible ALL METAL
COUPLINGS

Engineered to stand up on the toughest jobs, Thomas Flexible Couplings do not depend on springs, gears, rubber or grids to drive. All power is transmitted by direct pull.



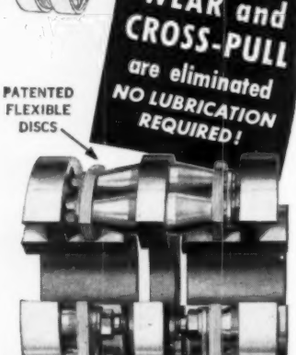
The standard line of Thomas Couplings meets practically all requirements. But if unusual conditions exist we are equipped to engineer and build special couplings.





BACKLASH FRICTION WEAR and CROSS-PULL are eliminated NO LUBRICATION REQUIRED!

PATENTED FLEXIBLE DISCS



THE THOMAS PRINCIPLE GUARANTEES PERFECT BALANCE UNDER ALL CONDITIONS OF MISALIGNMENT

Write for New Engineering Catalog

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA

New Cummins Diesel Announced

A NEW Cummins Diesel Engine, based on the well-known "Model H," yet developing 10 per cent more horsepower, was placed in production last month by Cummins Engine Company, Inc., Columbus, Ind.

The new Cummins diesel, designated the HR-600 engine, continues the Cummins trend toward "more power per pound" initiated with the introduction of the H-600 engine in 1932 and continued with the NH-600 engine four years ago.

The HR-600 engine develops 165 hp. (maximum) at 1800 rpm., with 5⅛ in. bore and 6 in. stroke. Piston displacement is 743 cubic inches. Like all Cummins diesels, the HR-600 is four-stroke cycle and has the Exclusive Cummins Fuel System.

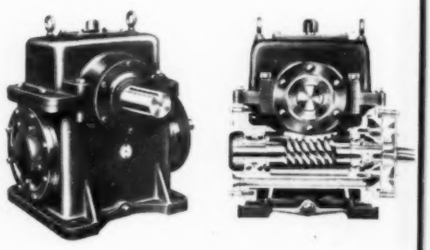
The new HR-600 is available in an automotive model, HRB-600; three industrial models, HRBI-600, HRI-600, and HRP-600, and a marine model, HRM-600. Model HRBI-600 is the basic industrial model, Model HRI-600 is equipped with instrument panel and trunnion support base, and Model HRP-600 is an enclosed power unit with structural steel base, clutch power take-off, radiator, fan, engine hood and fuel tank.

Field conversion to HR-600 from H-600 can be made by Cummins dealers. Steps involved include boring the present block and installing HR-600 pistons and liners and the optional installation of the new increased-flow lubricating system and continuous groove bearings.

Complete information on the new HR-600 Cummins diesel engine may be obtained from Cummins dealers, from manufacturers offering Cummins diesels as standard or optional power in their equipment, or by writing to Cummins Engine Company, Inc., Columbus, Ind.

New-Hypower Enclosed Worm Gear Drives Developed by Foote Bros.

FOOTE Bros. recently announced the introduction of a new line of enclosed worm gear drives in both horizontal and vertical types. Foote Bros. Hypower units, the manufacturer states, are smaller in size than conventional drives of equal capacity. They deliver power at low cost and because of their high thermal capacity, they permit the use of a smaller, less expensive reducer which means a savings in original cost.



Two views of Hypower Enclosed Worm Gear Drive

Foote Bros. Hypower worm gear drives are available in horizontal and vertical types. In a wide range of standard ratios to meet practically any need. These units comply with the speed-ratio standards adopted by the American Gear Manufacturers Association (AGMA), and the National Electric Manufacturers Association (NEMA).

Bulletin HPA fully describing the new Foote Bros. Hypower enclosed worm gear drives and containing ratings and dimension tables is available on request to Foote Bros. Gear and Machine Corp., 4545 South Western Blvd., Chicago 9, Ill.

Sinclair Develops Rust Preventative

MANY diesel operators have long wanted an effective rust preventative to protect the inside surfaces of fuel and lube storage tanks from rust and other oxidation products. Recently the research engineers of the Sinclair Refining Company have developed a low cost compound which is said to fill the bill.

Known as RD-119, the newly-discovered fluid is now being added to all Sinclair petroleum products as they flow through pipelines to distribution points. Under this new process, all of the company's products, such as gasoline, kerosene, heating oil and diesel oil will contain an effective

Engineering Societies Meetings Scheduled

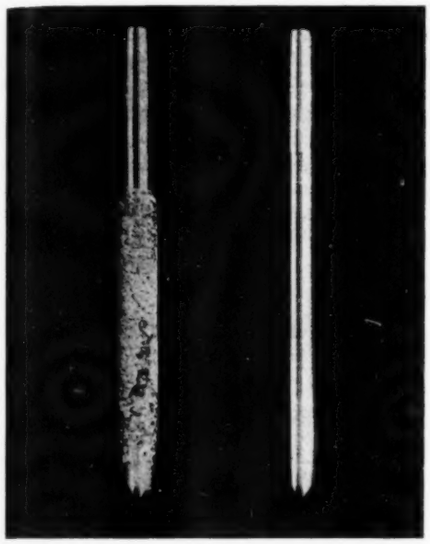
S.A.E. National Meetings

Aeronautic Meeting and Aircraft Display	The Biltmore	Los Angeles, Cal.	Oct. 6-9
Production Meeting and Clinic	Statler Hotel	Cleveland, O.	Oct.. 21-22
Fuels and Lubricants	The Mayo	Tulsa, Okla.	Nov. 4-5
	1949		
Annual Meeting and Engineering Display	Book-Cadillac Hotel	Detroit, Mich.	Jan. 10-14
Passenger Car, Body and Production Meeting	Book-Cadillac Hotel	Detroit, Mich.	March 8-10
Transportation Meeting	Statler Hotel	Cleveland, O.	March 28-30
Aeronautic and Air Transport Meeting	Hotel New Yorker	New York, N. Y.	April 11-13
Summer Meeting	French Lick Springs Hotel	French Lick, Ind.	June 5-10
West Coast Meeting	Multnomah Hotel	Portland, Ore.	August 17-19
Tractor (possibly diesel)		Milwaukee, Wisc.	September

A.S.M.E. National Meetings

Annual Meeting	Hotel Pennsylvania	New York, N. Y.	Nov. 28-Dec.
	1949		
Spring Meeting		New London, Conn.	May 2-4
Semi-Annual		San Francisco, Cal.	June 27-30
Fall Meeting		Erie, Pa.	Sept. 28-30
Annual Meeting	Hotel Pennsylvania	New York, N. Y.	Nov. 27-Dec.

portion of the rust inhibitor. The additive preserves the efficiency of petroleum products to which it is added.



Test results by the Research and Development Department of Sinclair Refining Company showing protection obtainable from use of RD-119. The steel bar on the left shows a heavy deposit of rust after immersion in ordinary kerosene. The steel bar on the right is completely rust-free after immersion for the same length of time in kerosene containing .007 volume per cent of RD-119.

Developed by Sinclair's Research Department, RD-119 is so highly efficient in eliminating rust and scale on metal surfaces that only a little more than two and a half gallons are required to give rust-preventing qualities to 42,000 gallons of petroleum products.

According to E. W. Isom, director of Sinclair's extensive research program, RD-119 provides an, "invisible, polymolecular protective layer, which prevents the metal surfaces from coming in contact with air and moisture, thus preventing rust and corrosion of such metals as steel, zinc, aluminum and brass."

Patent applications covering the development of RD-119 have been filed. However, license agreements will soon be available making RD-119 obtainable for use by other firms.

Fluorescent Lighting For Diesel Bus

SUCCESSFUL use of The Leece-Neville Company's standard 12-volt AC Alternator System in the lighting of buses with fluorescent lamps was revealed recently.

In a test conducted in a General Motors diesel bus operated by Chicago Motor Coach Company, the largest Leece-Neville production alternator now in use in the bus field, is being employed to supply power for a lighting system and embodying a new principle of operating fluorescent lamps at high frequencies.

The new system employs a special circuit designed by General Electric Company engineers.

The Leece-Neville AC alternator, driven directly from the engine, supplies the necessary AC current for the fluorescent lamps, and has an ample reserve to furnish DC current for cranking, air conditioning and heater motors, headlights, marker lights, and battery maintenance.

Multi-Purpose Clamps

SAVINGS in servicing large armatures and commutators are being effected through the use of Multi-Purpose Clamps made by Marman Products Co.

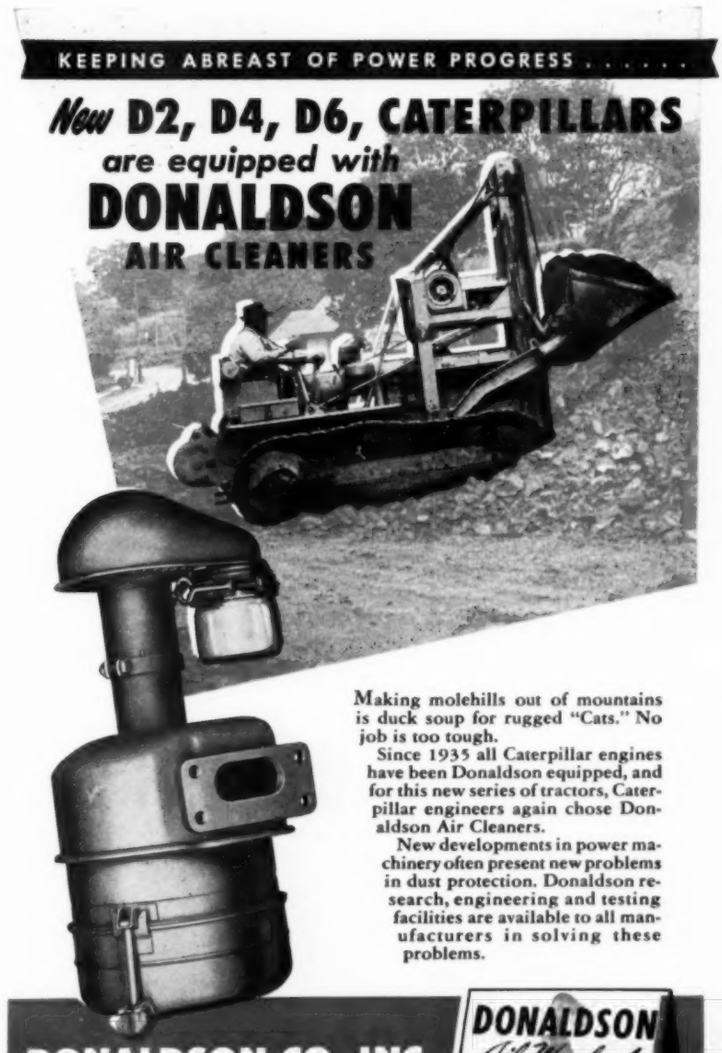
These clamps have been adopted by several large electrical service shops to pull coils into place when re-winding armatures. In the past it has been necessary to use a wire banding machine to accomplish this purpose—an expensive and time consuming process. By simply wrapping the Multi-Purpose Clamp around each layer of coils and tightening locking device and take-up screw, intense pressure can be applied to force coils into position for final banding. It is estimated that as much as six hours are saved on large jobs. The clamp is also used to advantage to hold commutator segments while assembling and processing.

Marmon Multi-Purpose clamp holding Commutator segments.

The clamp consists of a tough, interchangeable, stainless steel strap furnished in 1½ to 2 in. width of any desired length, a square swivel assembly and take-up and locking screws of cold-rolled steel. For further information write Marman Products Co., Inc., 940 W. Florence Avenue, Inglewood, California.

KEEPING ABREAST OF POWER PROGRESS . . . . . .

New D2, D4, D6, CATERPILLARS *are equipped with* DONALDSON AIR CLEANERS



Making molehills out of mountains is duck soup for rugged "Cats." No job is too tough.

Since 1935 all Caterpillar engines have been Donaldson equipped, and for this new series of tractors, Caterpillar engineers again chose Donaldson Air Cleaners.

New developments in power machinery often present new problems in dust protection. Donaldson research, engineering and testing facilities are available to all manufacturers in solving these problems.

DONALDSON CO., INC.
666 PELHAM BLVD., ST. PAUL 4, MINN.
DONALDSON CO. (CANADA) LTD. CHATHAM, ONTARIO

DONALDSON Oil-Washed AIR CLEANERS

SALES ENGINEERS: CHICAGO • DETROIT • CLEVELAND

Maxim Evaporator-Distiller Bulletin

A NEW bulletin published by the Maxim Silencer Company describes its Evaporator-Distiller unit designed to produce from 1000 gallons of fresh water per day in a single effect plant to 10,000 gpd. in a double effect plant. Operating on low pressure steam and blowing off two gallons of brine concentrate for every gallon of fresh water it turns out, salt concentration is very low and scaling is minimized due to low temperature evaporation. It produces fresh water to a purity of .20 grains per gallon.

The unit is constructed entirely of Monel metal. Descaling is a simple task, since the construction of the corrugated heating surface is such that it flexes easily under vacuum. When cold sea water is introduced into the shell a vacuum is formed by the condensation of the steam and the corrugations are sucked inward, thus popping off the scale.

This Evaporator-Distiller has industrial as well as marine applications. For a copy of this bulletin write Maxim Silencer Co., Hartford, Conn.

Diesel Locomotive Starting Batteries Described in New Gould Bulletin

RAILROAD engineers, foremen, servicemen, and purchasing agents will want to obtain the new two-color eight page technical bulletin on batteries for diesel locomotive starting announced by the Gould Storage Battery Corporation.

The new literature includes liberal illustrations, descriptions, and full technical data on the Gould "Kathonode" Batteries.

Engineering specifications include unit dimensions, approximate net weight, ampere hour capacity at the eight hour discharge rate, and the number of cells per unit for the following models: (1) high type, high capacity, molded rubber monobloc container; (2) high type, high capacity, rubber jars in wood tray; (3) low type, thick plates, molded rubber monobloc container; (4) low type, thick plates, rubber jars in wood tray; (5) low type, standard plates, molded rubber monobloc container; and (6) low type, standard plates, rubber jars in wood tray. Graphs give high rate discharge characteristics for the six types listed.

Requests for the bulletins should refer to No. GB-779. Gould Storage Battery Corp., Trenton 7, New Jersey.

New Nordberg Bulletin

The Nordberg two-cycle Duafuel engine is described and pictured in a new bulletin, "Nordberg Gas Burning Diesels," published by Nordberg Mfg. Co.

The Duafuel engine is quickly convertible to either oil or natural gas fuel without changing pistons, heads, cylinders or other major parts. This dual fuel engine operates on the full Diesel principle when burning either gas or fuel oil, whichever is the most economical. The Bulletin contains a five-color drawing of the schematic arrangement of gas details and piping of Nordberg Duafuel Diesel engines. Also shown are several installation pictures.

Copies of this bulletin, No. 106-A, may be had upon request to Nordberg Mfg. Co., Milwaukee 7, Wisconsin.

New Morse-Formsprag Clutch Catalog Available

MORSE CHAIN COMPANY, Detroit, has a brand-new 16-page, 2-color catalog ready for distribution on request. The catalog is devoted to the new Morse-Formsprag Full Complement Over-Running Clutch, its construction, development and working principle. The new catalog gives engineering diagrams of special designs at work with the Morse-Formsprag Clutch integrated within the designs.

The new Morse-Formsprag Catalog, C11-48, can be obtained by writing Dept. 22, Morse Chain Company, 7601 Central Ave., Detroit 8, Michigan.

Remember Letter Writing Week—October 17-23

THE MODERN LUBE OIL AND JACKET WATER COOLER—**GRAHAM MONOBOLT**

A compact and highly efficient cooler recommended for all engine services.
Graham Monobolt coolers may be disassembled for cleaning or inspection in a matter of minutes; they incorporate many other improvements in construction details that result in a top-notch cooler.
Deliveries are good and prices are competitive.
Ask for leaflet MP-119 for full details.

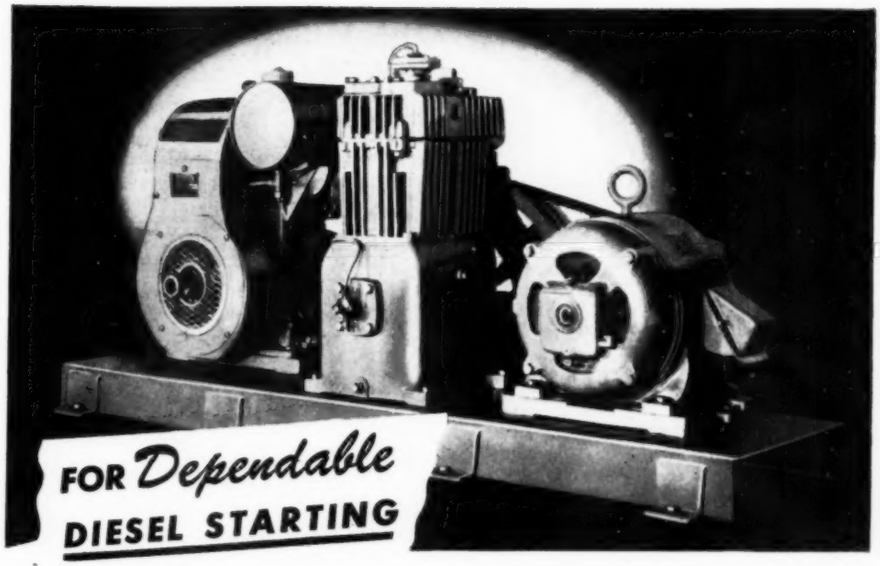
GRAHAM MANUFACTURING CO., INC. 415 Lexington Ave., New York 17, N.Y.

Power Show to Offer Equipment Designed for New Economies

THIS year's Power Show will reveal many ways to help check the inflation spiral at one of its numerous sources, as exhibitors emphasize equipment designed for new economies in the production, transmission and regulation of power. The big display, officially known as the 18th National Exposition of Power and Mechanical Engineering, will occupy four floors in Grand Central Palace, New York, November 29 to December 4.

Power demand is on the upgrade, with new plants accounting for a backlog of equipment orders running several years ahead, but the current need is pressing for means to step up existing plants and more especially to cut power costs wherever leaks can be plugged or higher efficiencies introduced. Devotion to these immediate and often urgent problems will constitute the theme of this year's exposition. New economies will be reflected in the long list of specialties, piping and valves, automatic recorders and controls, instruments for many purposes. Improved construction will be featured in pumps and compressors, fuel and materials handling equipment; variable transmissions and drives as well as many other kinds of power and power plant machinery.

The exposition is under the management of the International Exposition Company, Grand Central Palace, New York. Charles F. Roth is manager and E. K. Stevens, associate manager.



FOR *Dependable* DIESEL STARTING

Quincy Compressors for Diesel starting air supply are available in a wide variety of models. Model D320S shown above has proved highly satisfactory as a starting unit. Compressor can be operated by either electric motor or gasoline engine. This provides standby protection against current failure — eliminates extra investment in second compressor. Quincy Compressors are available in sizes 1 to 80 cu. ft. displacement, up to 500 pounds discharge pressure. Specify Quincy Compressors for *dependable Diesel starting.*

Quincy COMPRESSORS
QUINCY COMPRESSOR CO.
Department K-116, Quincy, Illinois
Branch Offices: New York • Chicago
St. Louis • San Francisco

DIESEL GENERATORS

IMMEDIATE DELIVERY

Three 100 kw., 60 cycle, 440 volt Worthington Diesels model BB-5, 150 HP, **600 RPM,** direct connected to Westinghouse Generators, Westinghouse-built switchboards: Equipped for parallel operation; Worthington evaporative condensers for cooling: Burgess mufflers: Air starting equipment. Can change to 50 cycles or reconnect to other voltage.

UNUSED! GUARANTEED!

Will sell individual units or as complete plant.

PRICED AT LESS THAN ENGINE VALUE ALONE

Write for Price and Specifications

Consolidated Diesel Electric CORPORATION
MOUNT VERNON, NEW YORK
MOUNT VERNON 8-9600

TRAINING MEN FOR THE DIESEL INDUSTRY

HEMPHILL SCHOOLS are your logical source of properly and thoroughly trained Diesel operators, maintenance and service men. You can rely upon Hemphill graduates who have chosen the Diesel field as their permanent vocation, and who chose Hemphill for their training because of its outstanding record and reputation.

HEMPHILL DIESEL SCHOOLS are the oldest in America devoted exclusively to Diesel training. Facilities include Diesel engines of various types and sizes, well equipped machine shops and laboratories.

GET THE KIND OF DIESEL MEN YOU WANT FROM HEMPHILL DIESEL SCHOOLS
Write today. No obligation
APPROVED FOR VETERANS—AVAILABLE FOR NON-VETERANS
HOME TRAINING also available. Many men now employed on Diesel jobs take this famous course to upgrade themselves.

HEMPHILL DIESEL SCHOOLS

NEW YORK
31-28 Queens Blvd.
Long Island City

MEMPHIS
311 S. Main Street
Tennessee

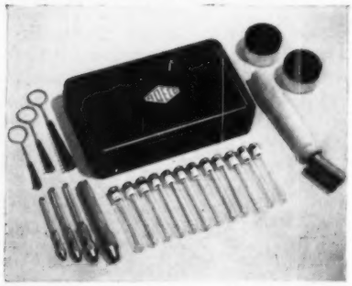
LOS ANGELES
1601 S. Western Avenue
California 6

KEEP YOUR DIESEL ENGINES OPERATING EFFICIENTLY

with these

ADECO

SERVICE AIDS



NEW ADECO NOZZLE SERVICE KIT FOR CLEANING INJECTORS

This handy kit includes all tools needed to clean out clogged nozzles and avoid possible damage to costly injectors. Complete with lapping compounds, in handy metal carrying case, *only $10.00 f. o. b. Chicago.*

• • • • • • • • • • • • • • • •

ADECO NOZZLE TESTER

Compact, portable, sturdy, precision-built. Enables any mechanic to make quick, accurate tests on injector opening pressure, spray pattern, etc., and detect stuck needle valves and leakage around valve seats. Pressures up to 10,000 p.s.i. Tests large or small injectors. *Complete with standard gauge, $75, f.o.b. Chicago;* slightly higher, equipped with Navy-approved gauge.

ADECO

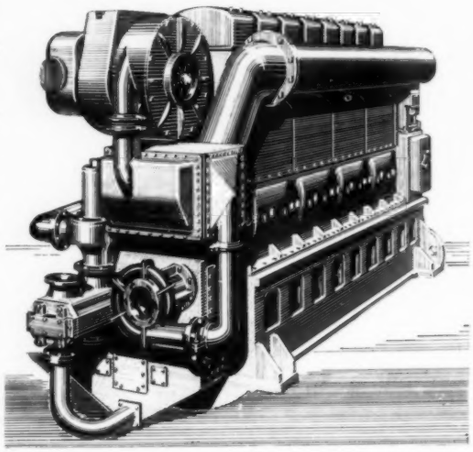
AIRCRAFT & DIESEL EQUIPMENT CORP.
4401 N. Ravenswood Avenue
Chicago 40, Illinois

Manufacturers of dependable Fuel Injection Pumps, Nozzles and Nozzle Holders for the Diesel Industry.

NEW LIMA-HAMILTON DIESEL

A BRAND NEW engine, just announced by the Lima-Hamilton Corporation, is now in production. This new diesel, rated at 1200 hp. in the 8 cylinder size is designed for railroad, stationary and marine use.

The new engine is sturdily constructed with a block of welded steel, furnace stress relieved. All working parts are accessible through crankpit covers. The cylinder heads are of cast Meehanite iron with all auxiliary moving parts completely enclosed. Two exhaust and inlet valves are located in each cylinder head. Cylinder heads can be tightened without removing valve gear. The cylinder liners are cast of special wear resisting iron with a wet type seal between the liner and the bottom of the block. Telltale holes provide positive indication of the tightness of the seal. The liner is water-cooled over the entire area of ring travel. The pistons are forged aluminum and carry 7 rings. They are oil cooled. Connecting rods are die-forged alloy steel, two piece, rifle-drilled to carry oil to floating type wrist pins. The crank shaft is drop forged from alloy steel. It is hung in nine precision main bearings. It is counterweighted and equipped with vibration dampers. Bearing shells can be removed through crankcase inspection doors without removing main bearing saddles.



Drawing of new 1200 hp 8 cylinder, supercharged Lima-Hamilton diesel engine.

The subbase is of welded steel and extends the entire length of the cylinder block. It is designed for 4 point suspension.

The length of the 6-cylinder model is 11′ 2¼″; that of the 8-cylinder model is 13′ 5¼″. Both engines are 4 cycle, available supercharged or normally aspirated.

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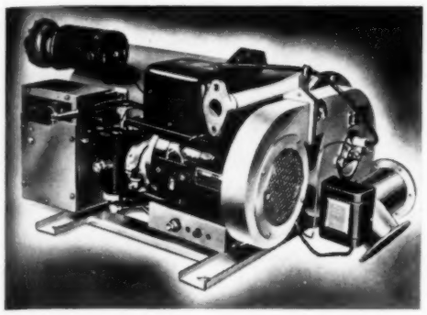
BENDIX TROPHY RACE SEPTEMBER 4

ECLIPSE MACHINE DIVISION of ELMIRA, NEW YORK

Bendix AVIATION CORPORATION

New Engine Heater

A 75,000 btu. heater for bus use is the latest development of the Petroleum Heat and Power Company. In the design and test stage for several years, the new heater is ready for distribution. Briefly the new heater is a miniature heating plant which will operate on either diesel oil



Petro engine heater

or gasoline. Its dimensions-26½×19×13⅛ inches –make for simple installation in the rear engine compartment of modern buses. Several design refinements have been incorporated in the heater which make for safe and dependable operation. The first is the utilization of a "purge period" of 90 seconds before fuel ignition. During this period the blower clears the combustion space of residual fuel thus preventing "puffs" or minor explosions. The second is the utilization of a standard a.c. ignition system, such as is used for home burner installations.

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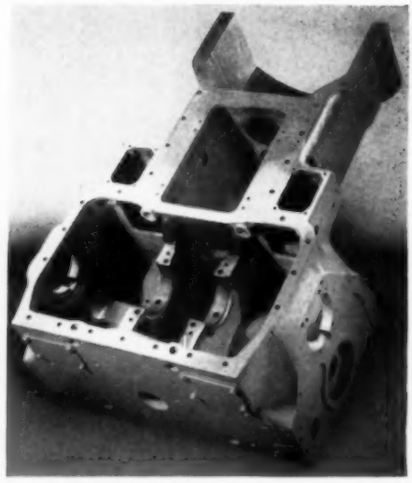

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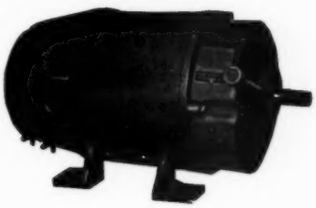
GENERATORS AC and DC



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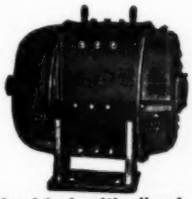

DC generator (left) two - bearings, self excited type Can also be furnished with direct connected exciter. Both AC and DC generators can be furnished in the single bearing, flange-mounted type for special mounting requirements. Ball bearing construction is used throughout. Complete data upon request.

Illustrated are AC generators, only 2 of the many different types developed and designed to fit specific needs and applications, (upper left) two-bearing self-excited type; (lower right) two-bearing direct connected exciter type.

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Founded in 1927

West Coast Diesel News

AT THE NATIONAL IRON WORKS shipyards: the first multiple launching in San Diego Harbor; the vessels, 48 ft. shrimp trawlers for Productos Congelados, Guaymas, Sonora, Mexico, *Juan Francisco, Santa Clara, Barco de Oro, Argonauta,* of welded steel construction, each powered with Lorimer, 6-cyl. 100 hp. diesels, also driving 2" Fairbanks Morse bilge pumps.

THE McDONALD LOGGING CO., Portland, Ore. has just taken delivery of 15 International heavy duty trucks, powered with Cummins 200 hp. diesel engines; equipped also with Hydrotarders, the trucks will be used for logging at Redding, Calif.

NEARLY 300 DIESEL-ENGINED local tuna vessels, (20 tons or more) comprise San Diego's fifty million dollar fleet, providing a $102,000,000 retail value tuna pack, including by-products, for packing plants valued at $8,000,000.

JUST CONVERTED at the Alameda yards, Bethlehem Shipbuilding Division, a Navy LST is now the 328 ft. *Rio Douro,* powered with two 900 hp. General Motors diesels, three 100 kw. GM auxiliary generators, to operate as freighter for E. G. Fontes & Co., Rio de Janeiro, north to Trinidad, south to Buenos Aires.

FOUR MORE 300 HP. SUPERIOR natural gas engines purchased from National Supply Co., Los Angeles, by State Tractor & Equip. Co., Phoenix, Ariz. will be used for irrigation purposes in the Queen Creek area, Maricopa County.

NEW 38 FT. COMBINATION fishing boat under construction by Manuel and George Line, Sausalito, is being powered with an 85-hp. General Motors diesel, with 3:1 reverse and reduction gear, purchased from West Coast Engine & Equip. Co., Berkeley.

POWERED WITH a 425 hp. Atlas diesel: auxilaries a pair of GM 125 hp.—60 kw. diesel-

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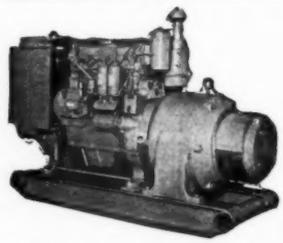

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generating sets, the new *Mary C. Canas*, built by Puget Sound Boat Bldg. Co., Tacoma, is the fifth major tuna clipper for Capt Joaquin "Jack" Canas and partners Albino and Antonio Batista.

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QUINSAM III, 38 ft. welded steel tugboat, built by John Manly, New Westminster, for Elk River Timber Co., designed by H. C. Hanson, is powered with a 115 hp. "Caterpillar" diesel supplied through Finning Tractor & Equipment Co., Vancouver.

AFTER SERVING in a similar capacity with the Industrial Division of Packard Motor Co., J. M. Haughey has been appointed sales manager of Washington Iron Works, Seattle. Founded in 1882 and still directed by the Frink family, the Washington Iron Works has grown to be one of the most modern plants on the Pacific Coast, employing 500 people, covering an area of 10 acres. Besides diesel engines, the products include logging machinery and gold dredges, with many new products under development.

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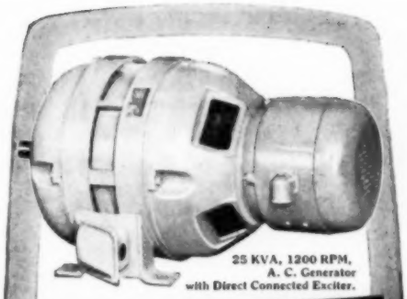

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